

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

January, 2006

APPENDIX 13-4
INFLOW PUMP STATION

INTAKE DESIGN

EAA RESERVOIR A-1 INFLOW PUMP STATION

FORMED SUCTION INTAKE GEOMETRY - HI 9.8

Capacity (cfs)	750
Capacity (gpm)	336623
Throat Diameter d (feet)	8.50
Width of FSI Opening W (feet)	19.64
Height of FSI Opening Hr (feet)	7.48
Length of FSI from Pump Centerline (feet)	28.05
FSI Opening Area D (sq feet)	147
Diameter of Circle Equivalent to FSI Opening D (sf)	13.68
Diameter D (inches)	164
Submergence (inches)	257
Submergence (ft)	21.4
Minimum Water Depth Above Floor	25.15
Low Water Shut Off Elevation	7.0
Intake Floor Slab Elevation	-18.15
Approach Velocity at Rack (fps)	1.32

EAA RESERVOIR A-1 INFLOW PUMP STATION**RECTANGULAR PUMP INTAKE GEOMETRY - HI 9.8**

Capacity (cfs)	600
Capacity (gpm)	269298
Bell Area (sq ft)	109.08
Bell Diameter (ft)	11.79
Bell Diameter (inches)	141
Submergence (inches)	234
Submergence (ft)	19.5
Distance Bell Centerline to Entrance (ft)	58.9
Distance Bell Centerline to Backwall (ft)	8.8
Distance Bell Inlet to Floor (ft)	5.9
Bay Width (ft)	23.6
Minimum Water Depth Above Floor	25.41
Low Water Shut Off Elevation	7.0
Intake Floor Slab Elevation	-18.41
Approach Velocity (fps)	1.00

EAA RESERVOIR A-1 INFLOW PUMP STATION**RECTANGULAR PUMP INTAKE GEOMETRY - HI 9.8**

Capacity (cfs)	1,000
Capacity (gpm)	448830
Bell Area (sq ft)	181.80
Bell Diameter (ft)	15.22
Bell Diameter (inches)	183
Submergence (inches)	288
Submergence (ft)	24.0
Distance Bell Centerline to Entrance (ft)	76.1
Distance Bell Centerline to Backwall (ft)	11.4
Distance Bell Inlet to Floor (ft)	7.6
Bay Width (ft)	30.4
Minimum Water Depth Above Floor	31.61
Low Water Shut Off Elevation	7.0
Intake Floor Slab Elevation	-24.61
Approach Velocity (fps)	1.04

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

SYSTEM HYDRAULIC ANALYSIS

EAA RESERVOIR A-1 INFLOW PUMP STATION**(3) 1000 cfs Vertical Axial Flow Pumps****PUMP ANALYSIS - SUCTION REQUIREMENTS**

Submergence at Rated Conditions (feet)	24.2
Distance from Impeller to Bell or Center of FSI	10.0
Vapor Pressure (feet)	1.2
Atmospheric Pressure (feet)	33.9
NPSHA (feet)	46.9
Q at Runout Conditions (estimated gpm)	538,560
Suction Specific Speed (assumed)	8,500

Maximum Pump Rotative Speed (rpm)	208
--	------------

Speed Factor - Maintain Speed in Range 50 to 120 fps	2.77
Head at BEP (feet)	13.0
Stages	1
Q at BEP (gpm)	448,833
Impeller Peripheral Velocity (fps)	80.15
Impeller Diameter D ₂ (feet)	10.00
Impeller RPM	153

Specific Speed	14987
-----------------------	--------------

Static Head (feet)	8.5
Dynamic Head (feet)	5.8
Q Rate of Flow (cfs)	1000
System Efficiency	0.78

Specific Energy	1144
------------------------	-------------

EAA RESERVOIR A-1 INFLOW PUMP STATION**(3) 1000 cfs Horizontal Axial Flow Pumps****PUMP ANALYSIS - SUCTION REQUIREMENTS**

Submergence at Rated Conditions (feet)	24.2
Distance from Impeller to Bell or Center of FSI	30.0
Vapor Pressure (feet)	1.2
Atmospheric Pressure (feet)	33.9
NPSHA (feet)	26.9
Q at Runout Conditions (estimated gpm)	538,560
Suction Specific Speed (assumed)	8,500

Maximum Pump Rotative Speed (rpm) 137

Speed Factor - Maintain Speed in Range 50 to 120 fps	2.75
Head at BEP (feet)	10.0
Stages	1
Q at BEP (gpm)	448,833
Impeller Peripheral Velocity (fps)	69.79
Impeller Diameter D ₂ (feet)	10.25
Impeller RPM	130

Specific Speed 15499

Static Head (feet)	6.0
Dynamic Head (feet)	6.6
Q Rate of Flow (cfs)	1000
System Efficiency	0.78

Specific Energy 1008

EAA RESERVOIR A-1 INFLOW PUMP STATION**(4) 750 cfs Vertical Axial Flow Pumps****PUMP ANALYSIS - SUCTION REQUIREMENTS**

Submergence at Rated Conditions (feet)	21.4
Distance from Impeller to Bell or Center of FSI	8.0
Vapor Pressure (feet)	1.2
Atmospheric Pressure (feet)	33.9
NPSHA (feet)	46.1
Q at Runout Conditions (estimated gpm)	403,950
Suction Specific Speed (assumed)	8,500

Maximum Pump Rotative Speed (rpm) 237

Speed Factor - Maintain Speed in Range 50 to 120 fps	2.25
Head at BEP (feet)	20.0
Stages	1
Q at BEP (gpm)	336,624
Impeller Peripheral Velocity (fps)	80.75
Impeller Diameter D ₂ (feet)	8.50
Impeller RPM	182

Specific Speed 11136

Static Head (feet)	12.0
Dynamic Head (feet)	8.0
Q Rate of Flow (cfs)	750
System Efficiency	0.78

Specific Energy 1600

EAA RESERVOIR A-1 INFLOW PUMP STATION**(5) 600 cfs Vertical Axial Flow Pumps****PUMP ANALYSIS - SUCTION REQUIREMENTS**

Submergence at Rated Conditions (feet)	19.5
Distance from Impeller to Bell or Center of FSI	6.0
Vapor Pressure (feet)	1.2
Atmospheric Pressure (feet)	33.9
NPSHA (feet)	46.2
Q at Runout Conditions (estimated gpm)	323,160
Suction Specific Speed (assumed)	8,500

Maximum Pump Rotative Speed (rpm) 265

Speed Factor - Maintain Speed in Range 50 to 120 fps	2.58
Head at BEP (feet)	15.0
Stages	1
Q at BEP (gpm)	269,300
Impeller Peripheral Velocity (fps)	80.19
Impeller Diameter D ₂ (feet)	7.50
Impeller RPM	204

Specific Speed 13910

Static Head (feet)	5.8
Dynamic Head (feet)	9.3
Q Rate of Flow (cfs)	600
System Efficiency	0.78

Specific Energy 1208

**EAA RESERVOIR A-1 INFLOW PUMP STATION
ALTERNATIVE 5
(5) 600 cfs Vertical Axial Flow Pumps**

PUMP ANALYSIS - SUCTION REQUIREMENTS

Submergence at Rated Conditions (feet)	19.5
Distance from Impeller to Bell or Center of FSI	6.0
Vapor Pressure (feet)	1.2
Atmospheric Pressure (feet)	33.9
NPSHA (feet)	46.2
Q at Runout Conditions (estimated gpm)	323,160
Suction Specific Speed (assumed)	8,500

Maximum Pump Rotative Speed (rpm) 265

Speed Factor - Maintain Speed in Range 50 to 120 fps	2.58
Head at BEP (feet)	15.0
Stages	1
Q at BEP (gpm)	269,300
Impeller Peripheral Velocity (fps)	80.19
Impeller Diameter D ₂ (feet)	8.00
Impeller RPM	192

Specific Speed 13040

Static Head (feet)	12.0
Dynamic Head (feet)	6.6
Q Rate of Flow (cfs)	387
System Efficiency	0.78

Specific Energy 1488

10

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 1 - 1000 CFS (448,833 GPM) PUMP								<p>Max. Static Head w/ Siphon = 15.0 ft. Max. Static Head w/o Siphon = 23.0 ft. at 80% cap. Min. Static Head w/ Siphon = -4.0 ft. Min. Static Head w/o Siphon = 16.0 ft. Head w/ siphon at rated capacity = 7.5 ft. Start-up: el.10.0 suction to mid-height of siphon = el. 26.0 ft. = 16.0 ft. Wet Season Average = 15.55 ft at 10.0 ft. suction Dry season Average = 17.55 ft. at 10.0 ft. suction Add 80 ft. for discharge tunnel length. Add 75 ft. for FSI Add 100 ft. for 90 elbow and 75 for 45 elbow Add 2.5 to static head for internal pump losses.</p>					BRAKE	
STATIC HEAD (FT)	INSIDE DIAMETER (IN)	PIPE LENGTH (FT)	C - FACTOR (100 TO 140)	BEND FACTOR (K)	BEGINNING GPM	GPM INCREMENT	SYSTEM EFFICIENCY	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	HP	
25.5	120	330	100	0.5	259,066	20,000	0.78	7.35	0.8	25.5	1.0	27.3	2290	
								7.92	1.0	25.5	1.1	27.6	2492	
								8.49	1.1	25.5	1.3	27.9	2700	
								9.06	1.3	25.5	1.4	28.2	2914	
								9.62	1.4	25.5	1.6	28.6	3134	
								10.19	1.6	25.5	1.8	28.9	3361	
								10.76	1.8	25.5	2.0	29.3	3595	
								11.33	2.0	25.5	2.2	29.7	3837	
								11.89	2.2	25.5	2.4	30.1	4087	
								12.46	2.4	25.5	2.7	30.6	4344	
								13.03	2.6	25.5	2.9	31.0	4611	
								13.60	2.9	25.5	3.1	31.5	4886	
								14.16	3.1	25.5	3.4	32.0	5171	

12

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 1 - 1000 CFS (448,833 GPM) PUMP									
STATIC HEAD (FT)	8.14								
INSIDE DIAMETER (IN)	120								
PIPE LENGTH (FT)	330								
C - FACTOR (100 TO 140)	100								
BEND FACTOR (K)	0.5								
BEGINNING GPM	348,833								
GPM INCREMENT	20,000								
SYSTEM EFFICIENCY	0.78								
		CFS	GPM	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
		777	348833	9.90	1.5	8.1	1.7	11.4	1284
		822	368833	10.47	1.7	8.1	1.9	11.7	1402
		866	388833	11.04	1.9	8.1	2.1	12.1	1527
		911	408833	11.60	2.1	8.1	2.3	12.5	1660
		955	428833	12.17	2.3	8.1	2.5	13.0	1801
		1000	448833	12.74	2.5	8.1	2.8	13.4	1951
		1045	468833	13.31	2.7	8.1	3.0	13.9	2109
		1089	488833	13.87	3.0	8.1	3.3	14.4	2277
		1134	508833	14.44	3.2	8.1	3.5	14.9	2454
		1178	528833	15.01	3.5	8.1	3.8	15.4	2641
		1223	548833	15.58	3.8	8.1	4.1	16.0	2838
		1267	568833	16.14	4.0	8.1	4.4	16.5	3047
		1312	588833	16.71	4.3	8.1	4.7	17.1	3266

14

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 2 - 1000 CFS (448,833 GPM) PUMP							
STATIC HEAD (FT)	20.5						
INSIDE DIAMETER (IN)	124						
PIPE LENGTH (FT)	300						
C - FACTOR (100 TO 140)	100						
BEND FACTOR (K)	0.5						
BEGINNING GPM	259,066						
GPM INCREMENT	20,000						
SYSTEM EFFICIENCY	0.78						
Max. Static Head w/ Siphon = 15.0 ft.							
Max. Static Head w/o Siphon = 18.0 ft. @ 80% rated cap.							
Min. Static Head w/ Siphon = -4.0 ft.							
Min. Static Head w/o Siphon = 11.0 ft.							
Head w/ siphon at rate capacity = 7.5 ft.							
Add 2.5 ft. to static head for internal pump losses.							
Add 50 ft. for discharge tunnel length							
Add 75 ft. for FSI							
Add 175 ft. for Elbows							
GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
259066	577	6.89	0.7	20.5	0.8	22.0	1847
279066	622	7.42	0.9	20.5	0.9	22.3	2012
299066	666	7.95	1.0	20.5	1.0	22.5	2181
319066	711	8.48	1.1	20.5	1.2	22.8	2355
339066	755	9.01	1.3	20.5	1.3	23.1	2534
359066	800	9.54	1.4	20.5	1.5	23.4	2719
379066	845	10.08	1.6	20.5	1.6	23.7	2911
399066	889	10.61	1.7	20.5	1.8	24.1	3108
419066	934	11.14	1.9	20.5	2.0	24.4	3313
439066	978	11.67	2.1	20.5	2.2	24.8	3524
459066	1023	12.20	2.3	20.5	2.4	25.2	3743
479066	1067	12.73	2.5	20.5	2.6	25.6	3969
499066	1112	13.27	2.7	20.5	2.8	26.0	4204

16

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 2 - 1000 CFS (448,833 GPM) PUMP							
STATIC HEAD (FT)	8.14						
INSIDE DIAMETER (IN)	124						
PIPE LENGTH (FT)	300						
C - FACTOR (100 TO 140)	100						
BEND FACTOR (K)	0.5						
BEGINNING GPM	348,833						
GPM INCREMENT	20,000						
SYSTEM EFFICIENCY	0.78						
Max. Static Head w/ Siphon = 15.0 ft.							
Max. Static Head w/o Siphon = 18.0 ft. @ 80% rated cap.							
Min. Static Head w/ Siphon = -4.0 ft.							
Min. Static Head w/o Siphon = 11.0 ft.							
Head w/ siphon at rate capacity = 7.5 ft.							
Wet Season Average = 15.64 ft. at 10.0 ft. suction							
Dry Season Average = 17.55 ft. at 10.0 ft. suction							
Add 2.5 ft. to static head for internal pump losses.							
Add 50 ft. for discharge tunnel length							
Add 75 ft. for FSI							
Add 175 ft. for Elbows							
		VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
GPM	CFS						
348833	777	9.27	1.3	8.1	1.4	10.9	1228
368833	822	9.80	1.5	8.1	1.6	11.2	1336
388833	866	10.34	1.7	8.1	1.7	11.5	1450
408833	911	10.87	1.8	8.1	1.9	11.9	1571
428833	955	11.40	2.0	8.1	2.1	12.2	1699
448833	1000	11.93	2.2	8.1	2.3	12.6	1834
468833	1045	12.46	2.4	8.1	2.5	13.0	1976
488833	1089	12.99	2.6	8.1	2.7	13.4	2127
508833	1134	13.53	2.8	8.1	2.9	13.9	2285
528833	1178	14.06	3.1	8.1	3.1	14.3	2452
548833	1223	14.59	3.3	8.1	3.3	14.8	2628
568833	1267	15.12	3.6	8.1	3.6	15.3	2813
588833	1312	15.65	3.8	8.1	3.8	15.8	3007

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 2 - 1000 CFS (448,833 GPM) PUMP		Max. Static Head w/ Siphon = 15.0 ft. Max. Static Head w/o Siphon = 18.0 ft. @ 80% rated cap. Min. Static Head w/ Siphon = -4.0 ft. Min. Static Head w/o Siphon = 11.0 ft. Head w/ siphon at rate capacity = 7.5 ft. Wet Season Average = 15.64 ft. at 10.0 ft. suction Dry Season Average = 17.55 ft. at 10.0 ft. suction Add 2.5 ft. to static head for internal pump losses. Add 50 ft. for discharge tunnel length Add 75 ft. for FSI Add 175 ft. for Elbows					
STATIC HEAD (FT)	10.05	VELOCITY	VELOCITY	STATIC	FRICTION	TOTAL	BRAKE
INSIDE DIAMETER (IN)	124	(FT/SEC)	HEAD (FT)	HEAD (FT)	HEAD (FT)	HEAD (FT)	Hp
PIPE LENGTH (FT)	300						
C - FACTOR (100 TO 140)	100						
BEND FACTOR (K)	0.5						
BEGINNING GPM	348,833						
GPM INCREMENT	20,000						
SYSTEM EFFICIENCY	0.78						
GPM	CFS	VELOCITY	VELOCITY	STATIC	FRICTION	TOTAL	BRAKE
		(FT/SEC)	HEAD (FT)	HEAD (FT)	HEAD (FT)	HEAD (FT)	Hp
348833	777	9.27	1.3	10.1	1.4	12.8	1444
368833	822	9.80	1.5	10.1	1.6	13.1	1564
388833	866	10.34	1.7	10.1	1.7	13.4	1691
408833	911	10.87	1.8	10.1	1.9	13.8	1824
428833	955	11.40	2.0	10.1	2.1	14.1	1964
448833	1000	11.93	2.2	10.1	2.3	14.5	2112
468833	1045	12.46	2.4	10.1	2.5	14.9	2266
488833	1089	12.99	2.6	10.1	2.7	15.3	2429
508833	1134	13.53	2.8	10.1	2.9	15.8	2600
528833	1178	14.06	3.1	10.1	3.1	16.2	2779
548833	1223	14.59	3.3	10.1	3.3	16.7	2967
568833	1267	15.12	3.6	10.1	3.6	17.2	3164
588833	1312	15.65	3.8	10.1	3.8	17.7	3371

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

ALL OTHERS

**EAA Reservoir Pump Station
 ALTERNATIVE 3 - 750 CFS (336,625 GPM) PUMP**

STATIC HEAD (FT) 14.75
 INSIDE DIAMETER (IN) 102
 PIPE LENGTH (FT) 550
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 236,625
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

Max. Static Head = 15.25 ft. @ 80% rated cap.
 Head at rated capacity = 12.25 ft.
 Min. Static Head = 8.25 ft.

Dry Season Average = 17.55 ft. at 10.0 suction
 Wet Season Average = 15.64 ft at 10.0 ft suction
 Add 350 ft. for flap valve
 Add 25 ft for discharge pipe
 Add 175 ft. for Elbows
 Add 75 ft. for FSI
 Add 2.5 ft. for internal pump losses

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
236625	527	9.30	1.3	14.8	2.4	18.5	1414
256625	572	10.08	1.6	14.8	2.8	19.1	1585
276625	616	10.87	1.8	14.8	3.2	19.8	1770
296625	661	11.65	2.1	14.8	3.6	20.5	1967
316625	705	12.44	2.4	14.8	4.1	21.3	2179
336625	750	13.22	2.7	14.8	4.6	22.1	2405
356625	795	14.01	3.0	14.8	5.1	22.9	2648
376625	839	14.80	3.4	14.8	5.7	23.8	2908
396625	884	15.58	3.8	14.8	6.3	24.8	3185
416625	928	16.37	4.2	14.8	6.9	25.8	3481
436625	973	17.15	4.6	14.8	7.5	26.9	3796
456625	1017	17.94	5.0	14.8	8.2	28.0	4132
476625	1062	18.72	5.4	14.8	8.9	29.1	4489

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

MAY

STATIC HEAD (FT) 17.75
 INSIDE DIAMETER (IN) 102
 PIPE LENGTH (FT) 550
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 169,300
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

EAA Reservoir Pump Station
ALTERNATIVE 3 - 750 CFS (336,625 GPM) PUMP
 Max. Static Head = 15.25 ft. @ 80% rated capacity
 Head at rated capacity = 12.25 ft.
 Min. Static Head = 9.25 ft.

Add 2.5 ft. for internal pump losses
 Add 25 ft for discharge pipe
 Add 350 ft. for flap valve
 Add 75 ft. for FSI
 Add 175 ft. for Elbows

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
169300	377	6.65	0.7	17.8	1.3	19.7	1079
189300	422	7.44	0.9	17.8	1.5	20.2	1235
209300	466	8.22	1.0	17.8	1.9	20.7	1401
229300	511	9.01	1.3	17.8	2.2	21.2	1576
249300	555	9.79	1.5	17.8	2.6	21.8	1763
269300	600	10.58	1.7	17.8	3.0	22.5	1962
289300	645	11.36	2.0	17.8	3.5	23.2	2174
309300	689	12.15	2.3	17.8	3.9	24.0	2400
329300	734	12.94	2.6	17.8	4.4	24.8	2640
349300	778	13.72	2.9	17.8	4.9	25.6	2896
369300	823	14.51	3.3	17.8	5.5	26.5	3169
389300	867	15.29	3.6	17.8	6.1	27.4	3459
409300	912	16.08	4.0	17.8	6.7	28.4	3768

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

DRY SEASON

STATIC HEAD (FT)	11.05	EAA Reservoir Pump Station
INSIDE DIAMETER (IN)	102	ALTERNATIVE 3A - 750 CFS (336,625 GPM) PUMP
PIPE LENGTH (FT)	300	
C - FACTOR (100 TO 140)	100	
BEND FACTOR (K)	0.5	Max. Static Head w/ siphon = 15. ft. @ 80% rated cap.
BEGINNING GPM	236,625	Head w/ siphon at rated capacity = 7.5 ft.
GPM INCREMENT	20,000	Min. Static Head w/o siphon = 8.25 ft.
SYSTEM EFFICIENCY	0.78	Max. Static Head w/o siphon 15.25 ft.
		Dry Season Average = 17.55 ft. at 10.0 ft. suction
		Wet Season Average = 15.64 ft. at 10.0 ft. suction
		Add 1.0 ft. for exit loss
		Add 50 ft. for discharge pipe
		Add 175 ft. for Elbows
		Add 75 ft. for FSI
		Add 2.5 ft. for internal pump losses

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
236625	527	9.30	1.3	11.1	1.6	14.0	1071
256625	572	10.08	1.6	11.1	1.9	14.5	1204
276625	616	10.87	1.8	11.1	2.1	15.0	1346
296625	661	11.65	2.1	11.1	2.5	15.6	1499
316625	705	12.44	2.4	11.1	2.8	16.2	1664
336625	750	13.22	2.7	11.1	3.1	16.9	1841
356625	795	14.01	3.0	11.1	3.5	17.6	2031
376625	839	14.80	3.4	11.1	3.9	18.3	2235
396625	884	15.58	3.8	11.1	4.3	19.1	2453
416625	928	16.37	4.2	11.1	4.7	19.9	2686
436625	973	17.15	4.6	11.1	5.1	20.8	2936
456625	1017	17.94	5.0	11.1	5.6	21.7	3202
476625	1062	18.72	5.4	11.1	6.1	22.6	3485

22

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

RATE

EAA Reservoir Pump Station
ALTERNATIVE 3A - 750 CFS (336,625 GPM) PUMP

STATIC HEAD (FT) 11
 INSIDE DIAMETER (IN) 102
 PIPE LENGTH (FT) 300
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 236,625
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

Max. Static Head w/ siphon = 15. ft. @ 80% rated cap.
 Head w/ siphon at rated capacity = 7.5 ft.
 Min. Static Head w/o siphon = 8.25 ft.
 Max. Static Head w/o siphon 15.25 ft.
 Dry Season Average = 17.55 ft. at 10.0 ft. suction
 Wet Season Average = 15.64 ft at 10.0 ft suction
 Add 1.0 ft. for exit loss
 Add 50 ft for discharge pipe
 Add 175 ft. for Elbows
 Add 75 ft. for FSI
 Add 2.5 ft. for internal pump losses

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
236625	527	9.30	1.3	11.0	1.6	13.9	1068
256625	572	10.08	1.6	11.0	1.9	14.4	1200
276625	616	10.87	1.8	11.0	2.1	15.0	1342
296625	661	11.65	2.1	11.0	2.5	15.6	1495
316625	705	12.44	2.4	11.0	2.8	16.2	1659
336625	750	13.22	2.7	11.0	3.1	16.8	1836
356625	795	14.01	3.0	11.0	3.5	17.5	2025
376625	839	14.80	3.4	11.0	3.9	18.3	2229
396625	884	15.58	3.8	11.0	4.3	19.1	2447
416625	928	16.37	4.2	11.0	4.7	19.9	2680
436625	973	17.15	4.6	11.0	5.1	20.7	2929
456625	1017	17.94	5.0	11.0	5.6	21.6	3194
476625	1062	18.72	5.4	11.0	6.1	22.5	3477

24

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA Reservoir Pump Station ALTERNATIVE 3A - 750 CFS (336,625 GPM) PUMP									
STATIC HEAD (FT)	18.5								
INSIDE DIAMETER (IN)	102								
PIPE LENGTH (FT)	300								
C - FACTOR (100 TO 140)	100								
BEND FACTOR (K)	0.5								
BEGINNING GPM	169,300								
GPM INCREMENT	20,000								
SYSTEM EFFICIENCY	0.78								
Max. Static Head w/ siphon = 15. ft. @ 80% rated cap. Head w/ siphon at rated capacity = 7.5 ft. Min. Static Head w/o siphon = 8.25 ft. Max. Static Head w/o siphon 15.25 ft. Dry Season Average = 17.55 ft. at 10.0 ft. suction Wet Season Average = 15.64 ft at 10.0 ft suction Add 1.0 ft. for exit loss Add 50 ft for discharge pipe Add 175 ft. for Elbows Add 75 ft. for FSI Add 2.5 ft. for internal pump losses									
	GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp	
	169300	377	6.65	0.7	18.5	0.8	20.0	1098	
	189300	422	7.44	0.9	18.5	1.0	20.4	1250	
	209300	466	8.22	1.0	18.5	1.3	20.8	1410	
	229300	511	9.01	1.3	18.5	1.5	21.3	1578	
	249300	555	9.79	1.5	18.5	1.8	21.8	1755	
	269300	600	10.58	1.7	18.5	2.0	22.3	1942	
	289300	645	11.36	2.0	18.5	2.3	22.8	2140	
	309300	689	12.15	2.3	18.5	2.7	23.5	2349	
	329300	734	12.94	2.6	18.5	3.0	24.1	2569	
	349300	778	13.72	2.9	18.5	3.4	24.8	2803	
	369300	823	14.51	3.3	18.5	3.7	25.5	3049	
	389300	867	15.29	3.6	18.5	4.1	26.3	3310	
	409300	912	16.08	4.0	18.5	4.5	27.1	3586	

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

WET SEASON 2nd MIN.

STATIC HEAD (FT) 9.25
 INSIDE DIAMETER (IN) 90
 PIPE LENGTH (FT) 150
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 169,300
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

**EAA Reservoir Pump Station
 ALTERNATIVE 4A - 600 CFS (269,300 GPM) PUMP**

Max. Static Head = 15.0 ft. @ 80% capacity
 Head at Rated Capacity = 7.75
 Min. Static Head = 1.75 ft.
 Wet Season Average = 15.64 ft. at 10.0 ft. suction
 Dry Season Average = 17.55 ft. at 10.0 ft. suction

Add 25 ft. for bell entrance
 Add 25 ft. for discharge pipe
 Add 1.0 ft. for exit loss.
 Add 100 ft. for elbow
 Add 2.5 ft. to static head for internal pump losses.

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
169300	377	8.54	1.1	9.3	1.0	11.4	625
189300	422	9.55	1.4	9.3	1.3	11.9	732
209300	466	10.56	1.7	9.3	1.5	12.5	849
229300	511	11.57	2.1	9.3	1.8	13.2	978
249300	555	12.58	2.5	9.3	2.2	13.9	1119
269300	600	13.59	2.9	9.3	2.5	14.6	1275
289300	645	14.60	3.3	9.3	2.9	15.4	1446
309300	689	15.61	3.8	9.3	3.3	16.3	1634
329300	734	16.62	4.3	9.3	3.7	17.2	1838
349300	778	17.62	4.8	9.3	4.2	18.2	2061
369300	823	18.63	5.4	9.3	4.6	19.3	2304
389300	867	19.64	6.0	9.3	5.1	20.4	2567
409300	912	20.65	6.6	9.3	5.6	21.5	2852

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

DRY SEASON

STATIC HEAD (FT)	12.05	EAA Reservoir Pump Station					ALTERNATIVE 4A - 600 CFS (269,300 GPM) PUMP				
INSIDE DIAMETER (IN)	90										
PIPE LENGTH (FT)	150										
C - FACTOR (100 TO 140)	100										
BEND FACTOR (K)	0.5										
BEGINNING GPM	169,300										
GPM INCREMENT	20,000										
SYSTEM EFFICIENCY	0.78										
Max. Static Head = 15.0 ft. @ 80% capacity Head at Rated Capacity = 7.75 Min. Static Head = 1.75 ft. Wet Season Average = 15.64 ft. at 10.0 ft. suction Dry Season Average = 17.55 ft. at 10.0 ft. suction											
Add 25 ft. for bell entrance Add 25 ft. for discharge pipe Add 1 ft. to static head for exit loss. Add 100 ft. for elbow Add 2.5 ft. to static head for internal pump losses.											
GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp				
169300	377	8.54	1.1	12.1	1.0	14.2	779				
189300	422	9.55	1.4	12.1	1.3	14.7	903				
209300	466	10.56	1.7	12.1	1.5	15.3	1038				
229300	511	11.57	2.1	12.1	1.8	16.0	1185				
249300	555	12.58	2.5	12.1	2.2	16.7	1345				
269300	600	13.59	2.9	12.1	2.5	17.4	1520				
289300	645	14.60	3.3	12.1	2.9	18.2	1709				
309300	689	15.61	3.8	12.1	3.3	19.1	1914				
329300	734	16.62	4.3	12.1	3.7	20.0	2137				
349300	778	17.62	4.8	12.1	4.2	21.0	2378				
369300	823	18.63	5.4	12.1	4.6	22.1	2639				
389300	867	19.64	6.0	12.1	5.1	23.2	2920				
409300	912	20.65	6.6	12.1	5.6	24.3	3223				

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

WET SEASON 3 MIN

**EAA Reservoir Pump Station
 ALTERNATIVE 4 - 600 CFS (269,300 GPM) PUMP**

STATIC HEAD (FT) 8.25
 INSIDE DIAMETER (IN) 90
 PIPE LENGTH (FT) 500
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 169,300
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

Max. Static Head = 15.0 ft. @ 80% capacity

Head at Rated Capacity = 7.75

Min. Static Head = 1.75 ft.

Wet Season Average = 15.64 ft. at 10.0 ft. suction

Dry Season Average = 17.55 ft. at 10.0 ft. suction

Add 25 ft. for bell entrance

Add 25 ft. for discharge pipe

Add 350 ft. for flap valve.

Add 100 ft. for elbow

Add 2.5 ft. to static head for internal pump losses.

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
169300	377	8.54	1.1	8.3	2.1	11.5	629
189300	422	9.55	1.4	8.3	2.6	12.2	751
209300	466	10.56	1.7	8.3	3.1	13.1	888
229300	511	11.57	2.1	8.3	3.7	14.0	1042
249300	555	12.58	2.5	8.3	4.3	15.0	1215
269300	600	13.59	2.9	8.3	5.0	16.1	1407
289300	645	14.60	3.3	8.3	5.8	17.3	1622
309300	689	15.61	3.8	8.3	6.5	18.6	1859
329300	734	16.62	4.3	8.3	7.4	19.9	2121
349300	778	17.62	4.8	8.3	8.2	21.3	2408
369300	823	18.63	5.4	8.3	9.1	22.8	2724
389300	867	19.64	6.0	8.3	10.1	24.3	3068
409300	912	20.65	6.6	8.3	11.1	26.0	3442

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

dry season

STATIC HEAD (FT) 11.05
 INSIDE DIAMETER (IN) 90
 PIPE LENGTH (FT) 500
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 169,300
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

EAA Reservoir Pump Station
ALTERNATIVE 4 - 600 CFS (269,300 GPM) PUMP
 Max. Static Head = 15.0 ft. @ 80% capacity
 Head at Rated Capacity = 7.75
 Min. Static Head = 1.75 ft.
 Wet Season Average = 15.64 ft. at 10.0 ft. suction
 Dry Season Average = 17.55 ft. at 10.0 ft. suction

Add 25 ft. for bell entrance
 Add 25 ft. for discharge pipe
 Add 350 ft. for flap valve.
 Add 100 ft. for elbow
 Add 2.5 ft. to static head for internal pump losses.

GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
169300	377	8.54	1.1	11.1	2.1	14.3	782
189300	422	9.55	1.4	11.1	2.6	15.0	922
209300	466	10.56	1.7	11.1	3.1	15.9	1077
229300	511	11.57	2.1	11.1	3.7	16.8	1250
249300	555	12.58	2.5	11.1	4.3	17.8	1441
269300	600	13.59	2.9	11.1	5.0	18.9	1651
289300	645	14.60	3.3	11.1	5.8	20.1	1884
309300	689	15.61	3.8	11.1	6.5	21.4	2139
329300	734	16.62	4.3	11.1	7.4	22.7	2419
349300	778	17.62	4.8	11.1	8.2	24.1	2725
369300	823	18.63	5.4	11.1	9.1	25.6	3058
389300	867	19.64	6.0	11.1	10.1	27.1	3421
409300	912	20.65	6.6	11.1	11.1	28.8	3813

30

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

RATED

EAA Reservoir Pump Station ALTERNATIVE 4A - 600 CFS (269,300 GPM) PUMP								
STATIC HEAD (FT)	11.25							
INSIDE DIAMETER (IN)	90							
PIPE LENGTH (FT)	150							
C - FACTOR (100 TO 140)	100							
BEND FACTOR (K)	0.5							
BEGINNING GPM	169,300							
GPM INCREMENT	20,000							
SYSTEM EFFICIENCY	0.78							
Max. Static Head = 15.0 ft. @ 80% capacity Head at Rated Capacity = 7.75 Min. Static Head = 1.75 ft. Wet Season Average = 15.64 ft. at 10.0 ft. suction Dry Season Average = 17.55 ft. at 10.0 ft. suction								
Add 25 ft. for bell entrance Add 25 ft. for discharge pipe Add 1.0 ft. for exit loss. Add 100 ft. for elbow Add 2.5 ft. to static head for internal pump losses.								
GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp	
169300	377	8.54	1.1	11.3	1.0	13.4	735	
189300	422	9.55	1.4	11.3	1.3	13.9	854	
209300	466	10.56	1.7	11.3	1.5	14.5	984	
229300	511	11.57	2.1	11.3	1.8	15.2	1126	
249300	555	12.58	2.5	11.3	2.2	15.9	1281	
269300	600	13.59	2.9	11.3	2.5	16.6	1450	
289300	645	14.60	3.3	11.3	2.9	17.4	1634	
309300	689	15.61	3.8	11.3	3.3	18.3	1834	
329300	734	16.62	4.3	11.3	3.7	19.2	2052	
349300	778	17.62	4.8	11.3	4.2	20.2	2288	
369300	823	18.63	5.4	11.3	4.6	21.3	2543	
389300	867	19.64	6.0	11.3	5.1	22.4	2819	
409300	912	20.65	6.6	11.3	5.6	23.5	3117	

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

MAX. CONDITION

EAA Reservoir Pump Station									
ALTERNATIVE 4 - 600 CFS (269,300 GPM) PUMP									
STATIC HEAD (FT)	17.5								
INSIDE DIAMETER (IN)	90								
PIPE LENGTH (FT)	500								
C - FACTOR (100 TO 140)	100								
BEND FACTOR (K)	0.5								
BEGINNING GPM	115,440								
GPM INCREMENT	20,000								
SYSTEM EFFICIENCY	0.78								
Max. Static Head = 15.0 ft. @ 80% capacity									
Head at Rated Capacity = 7.75									
Min. Static Head = 1.75 ft.									
Wet Season Average = 15.64 ft. at 10.0 ft. suction									
Dry Season Average = 17.55 ft. at 10.0 ft. suction									
Add 25 ft. for bell entrance									
Add 25 ft. for discharge pipe									
Add 350 ft. for flap valve.									
Add 100 ft. for elbow									
Add 2.5 ft. to static head for internal pump losses.									
GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp		
115440	257	5.82	0.5	17.5	1.0	19.0	712		
135440	302	6.83	0.7	17.5	1.4	19.6	859		
155440	346	7.84	1.0	17.5	1.8	20.2	1018		
175440	391	8.85	1.2	17.5	2.2	21.0	1190		
195440	435	9.86	1.5	17.5	2.7	21.7	1376		
215440	480	10.87	1.8	17.5	3.3	22.6	1578		
235440	525	11.88	2.2	17.5	3.9	23.6	1798		
255440	569	12.89	2.6	17.5	4.5	24.6	2037		
275440	614	13.90	3.0	17.5	5.2	25.7	2296		
295440	658	14.91	3.5	17.5	6.0	26.9	2577		
315440	703	15.92	3.9	17.5	6.8	28.2	2881		
335440	747	16.93	4.4	17.5	7.6	29.6	3211		
355440	792	17.93	5.0	17.5	8.5	31.0	3567		

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

MAX. HEAD

**EAA Reservoir Pump Station
 ALTERNATIVE 4A - 600 CFS (269,300 GPM) PUMP**

STATIC HEAD (FT) 18.5
 INSIDE DIAMETER (IN) 90
 PIPE LENGTH (FT) 150
 C - FACTOR (100 TO 140) 100
 BEND FACTOR (K) 0.5
 BEGINNING GPM 115,440
 GPM INCREMENT 20,000
 SYSTEM EFFICIENCY 0.78

Max. Static Head = 15.0 ft. @ 80% capacity
 Head at Rated Capacity = 7.75
 Min. Static Head = 1.75 ft.
 Wet Season Average = 15.64 ft. at 10.0 ft. suction
 Dry Season Average = 17.55 ft. at 10.0 ft. suction

Add 25 ft. for bell entrance
 Add 25 ft. for discharge pipe
 Add 1.0 ft. for exit loss.
 Add 100 ft. for elbow
 Add 2.5 ft. to static head for internal pump losses.

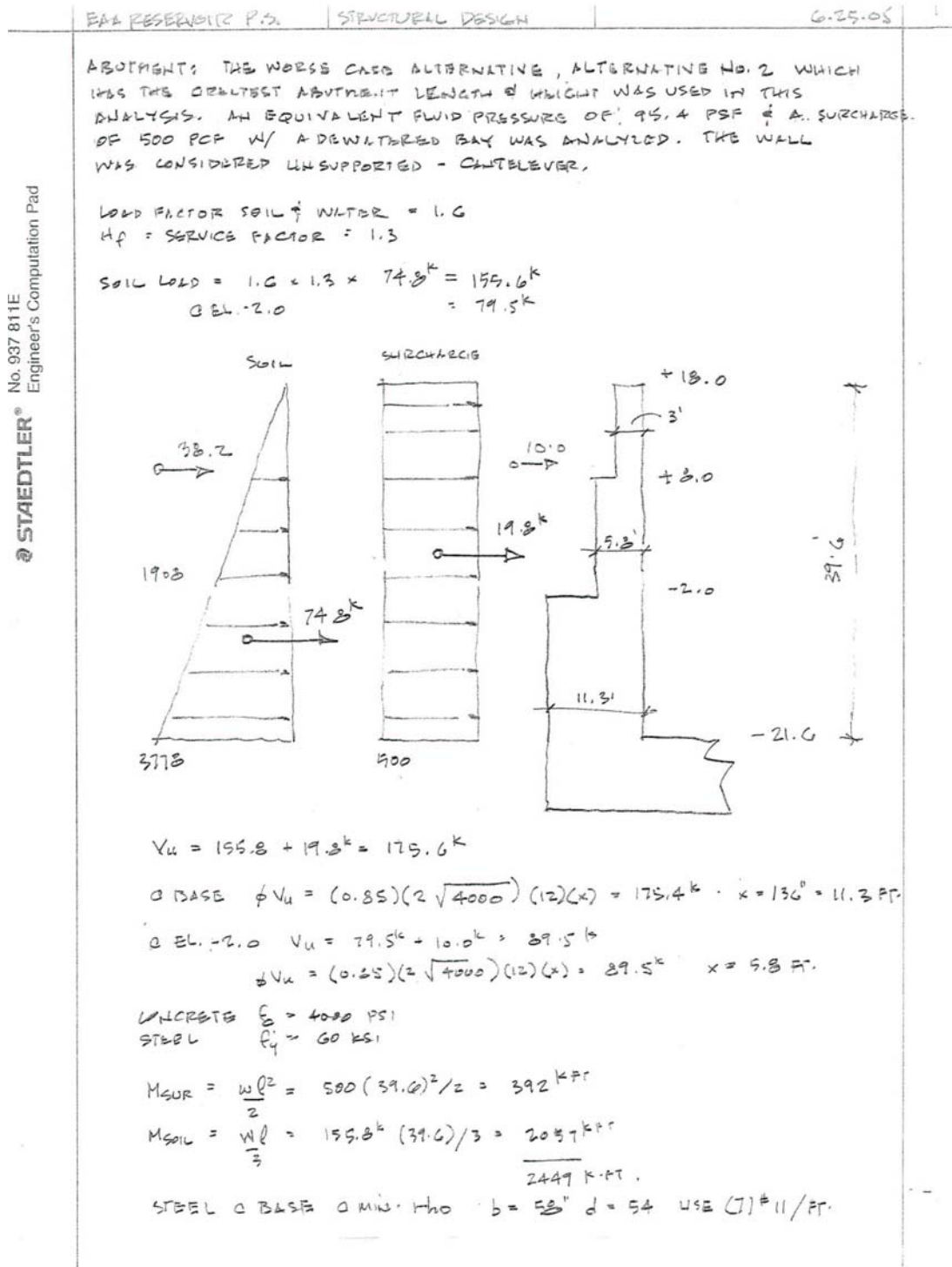
GPM	CFS	VELOCITY (FT/SEC)	VELOCITY HEAD (FT)	STATIC HEAD (FT)	FRICTION HEAD (FT)	TOTAL HEAD (FT)	BRAKE Hp
115440	257	5.82	0.5	18.5	0.5	19.5	729
135440	302	6.83	0.7	18.5	0.7	19.9	872
155440	346	7.84	1.0	18.5	0.9	20.3	1023
175440	391	8.85	1.2	18.5	1.1	20.8	1182
195440	435	9.86	1.5	18.5	1.4	21.4	1352
215440	480	10.87	1.8	18.5	1.6	22.0	1532
235440	525	11.88	2.2	18.5	1.9	22.6	1725
255440	569	12.89	2.6	18.5	2.3	23.3	1931
275440	614	13.90	3.0	18.5	2.6	24.1	2151
295440	658	14.91	3.5	18.5	3.0	25.0	2387
315440	703	15.92	3.9	18.5	3.4	25.8	2639
335440	747	16.93	4.4	18.5	3.8	26.8	2909
355440	792	17.93	5.0	18.5	4.3	27.8	3198

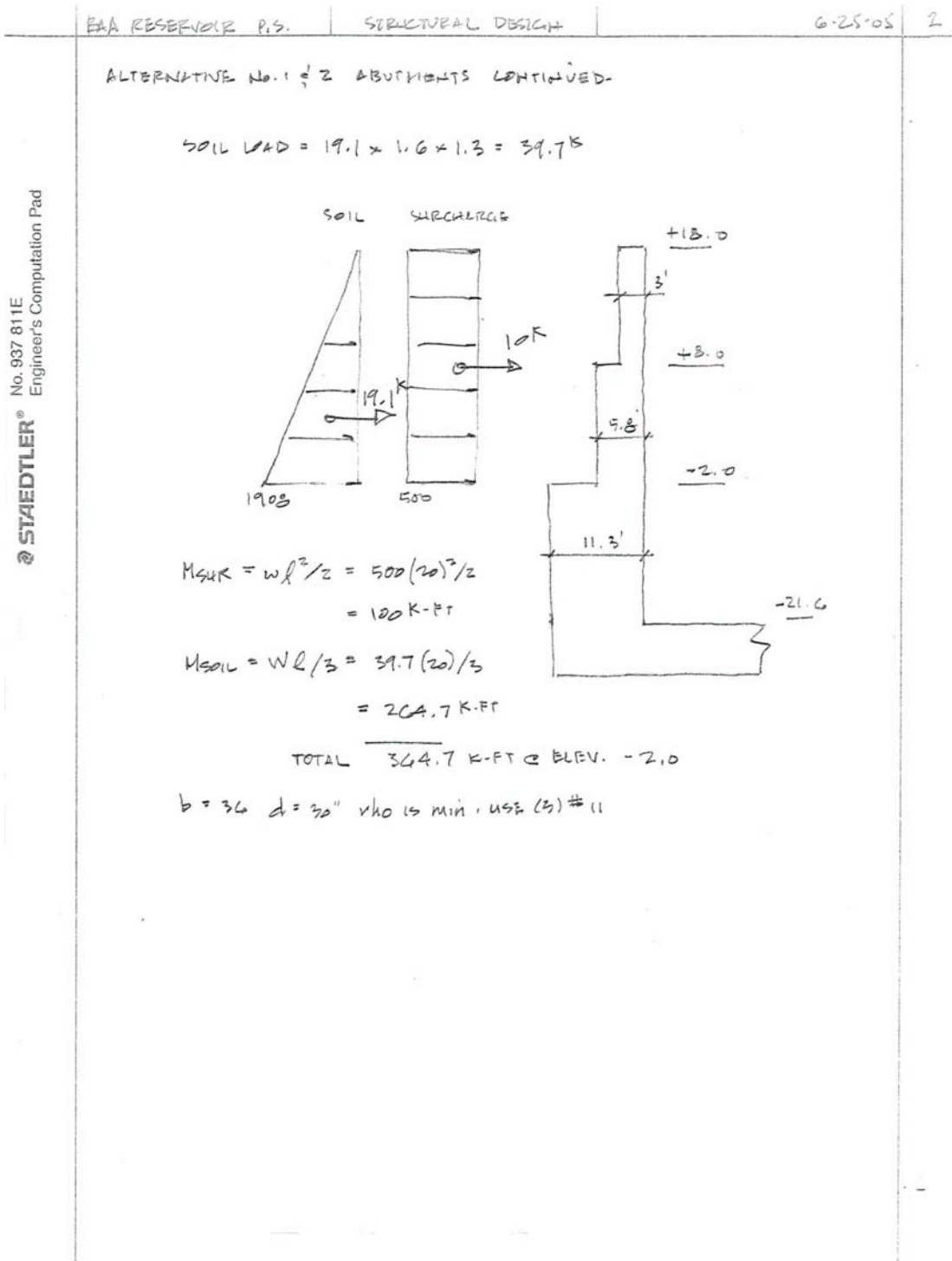
BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

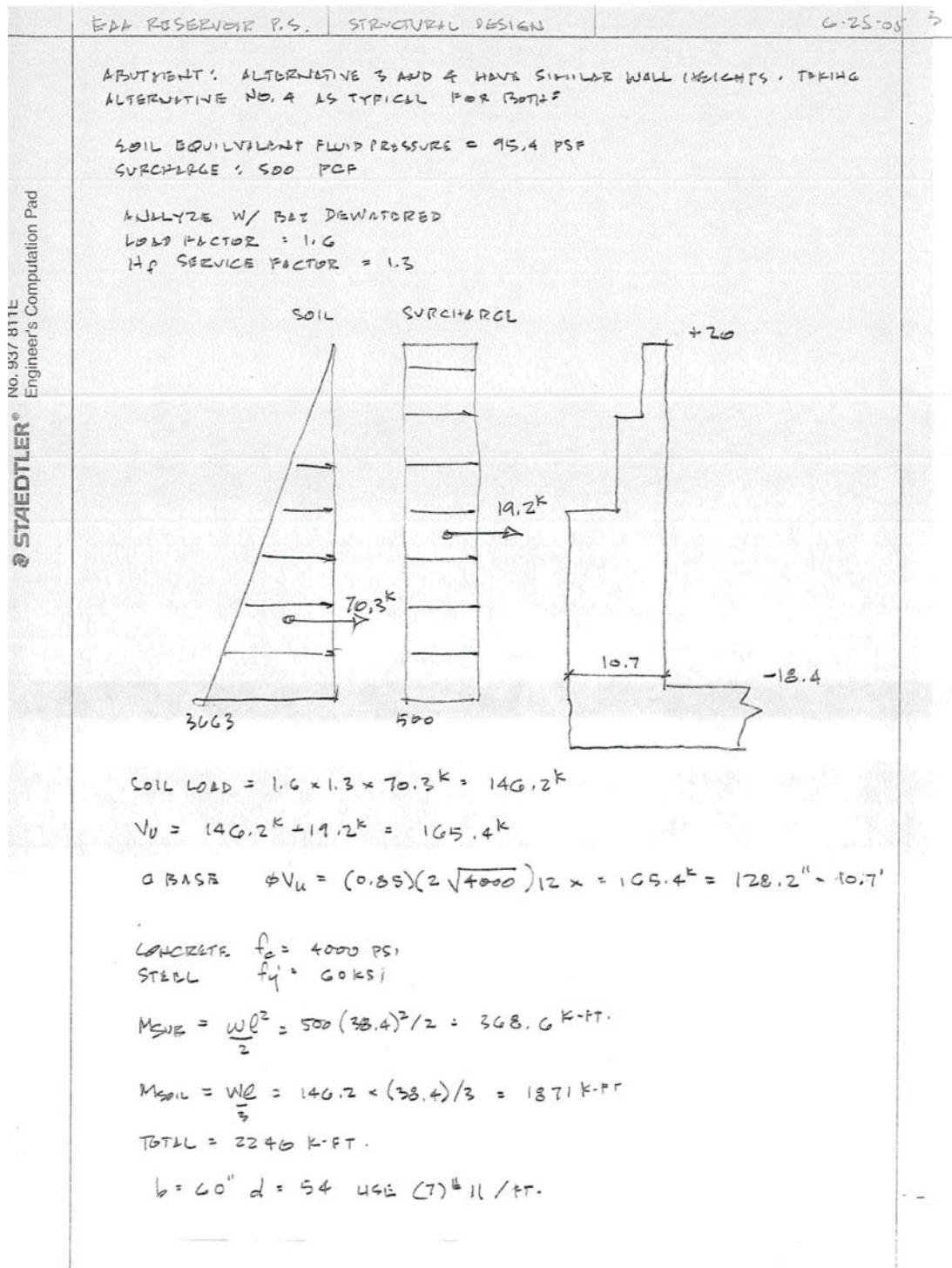
REINFORCED CONCRETE HAND CALCULATIONS





South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

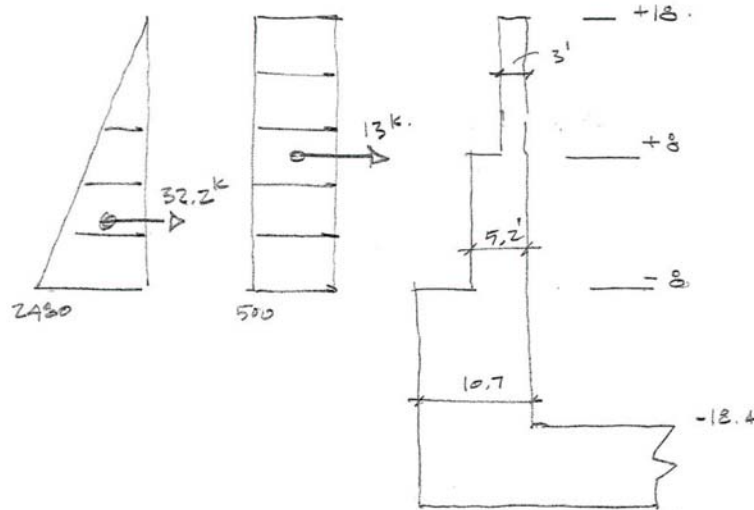


EAA RESERVOIR P.S. STRUCTURAL DESIGN

G-25-05 4

ALTERNATIVES NO. 3 AND 4 CONTINUED.

$$\text{SOIL LOAD (FACTORED)} = 32.2 \times 1.3 \times 1.0 = 67 \text{ K}$$



$$V_u = 67 \text{ K} + 13 \text{ K} = 80 \text{ K}$$

$$\text{at EL. } -8.0 \quad \phi V_u = (0.85)(2 \sqrt{4000}) 12 x = 80 \text{ K}$$

$$x = 62" = 5.17'$$

$$\text{CONCRETE: } f_c = 4000 \text{ PSI}$$

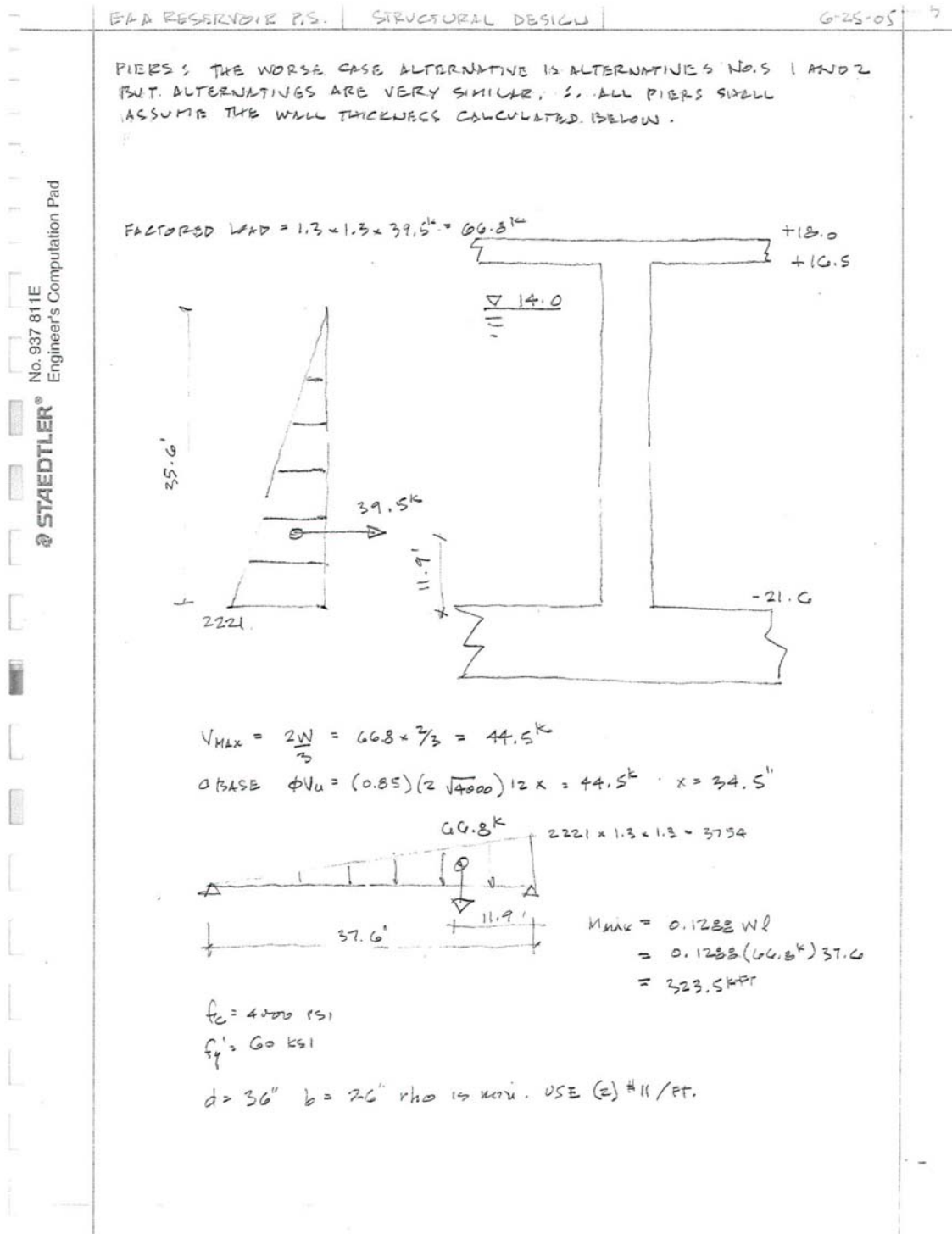
$$\text{STEEL: } f_y = 60 \text{ KSI}$$

$$M_{\text{SUR}} = w l^2 / 2 = 500(26)^2 / 2 = 169 \text{ K-FT}$$

$$M_{\text{SOIL}} = W l / 3 = 67(26) / 3 = 580.7 \text{ K-FT}$$

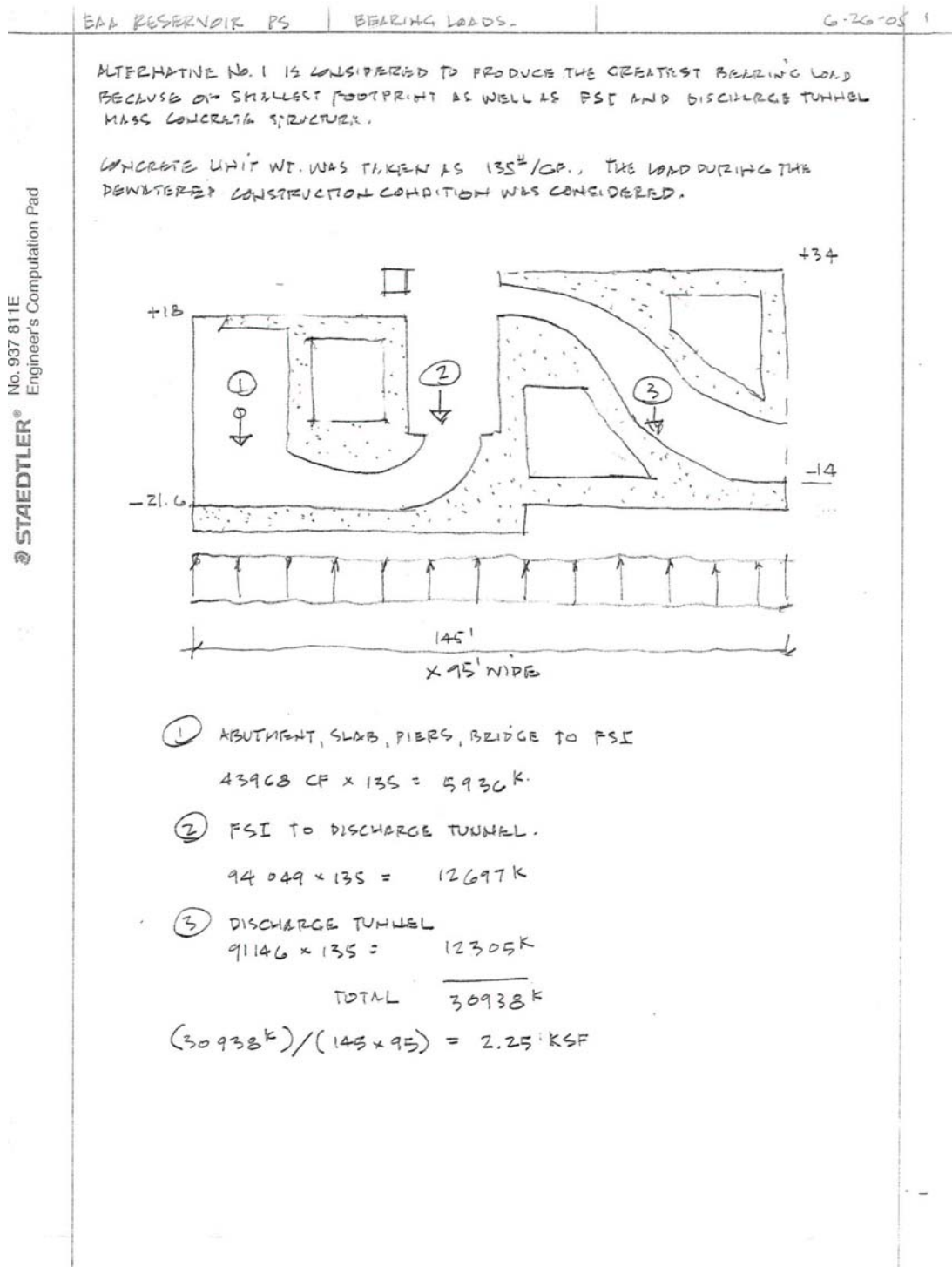
$$\overline{749.7 \text{ K-FT}}$$

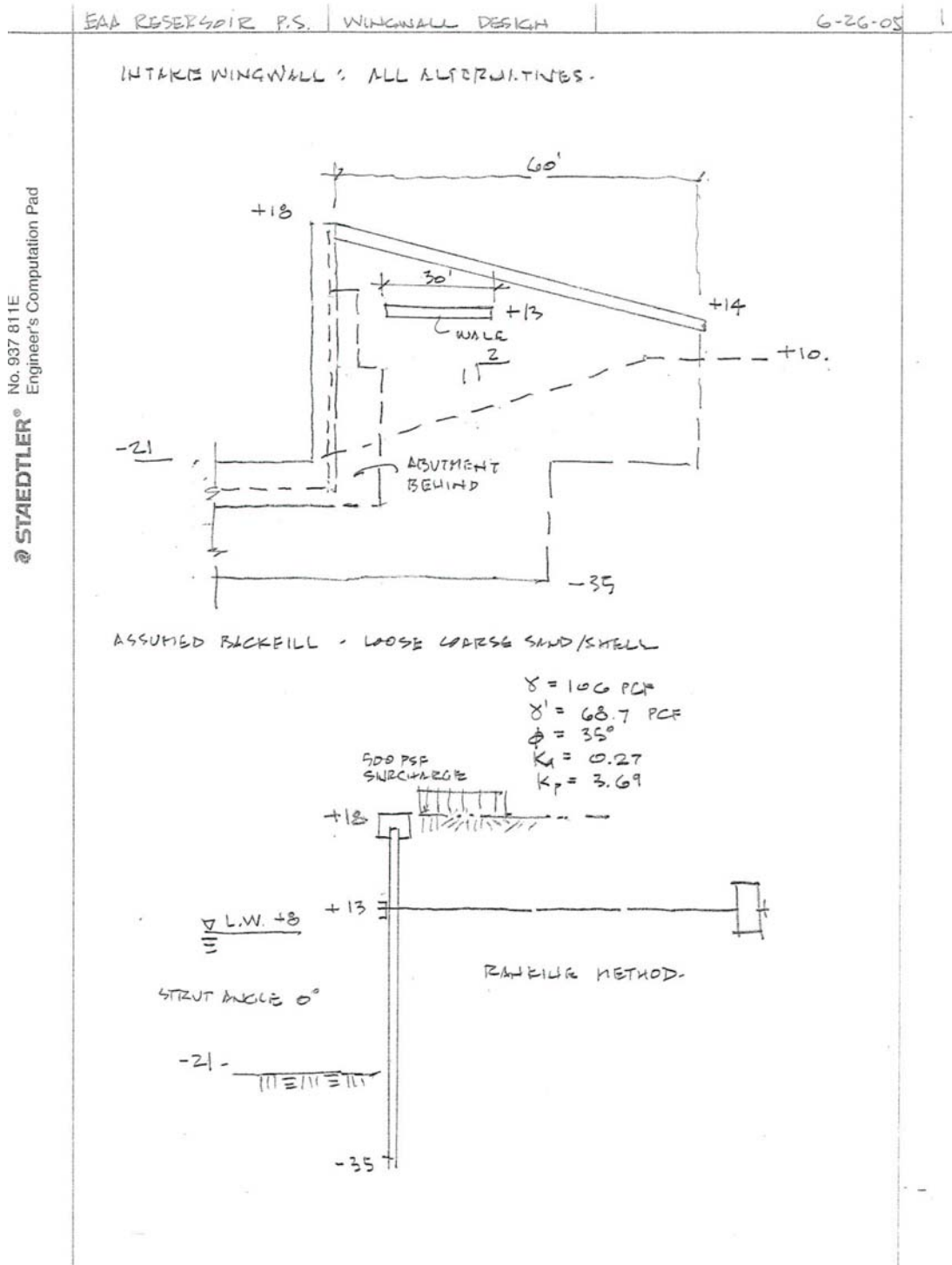
$$b = 40" \quad d = 30" \quad \text{rho is min. USE (3) \#11}$$

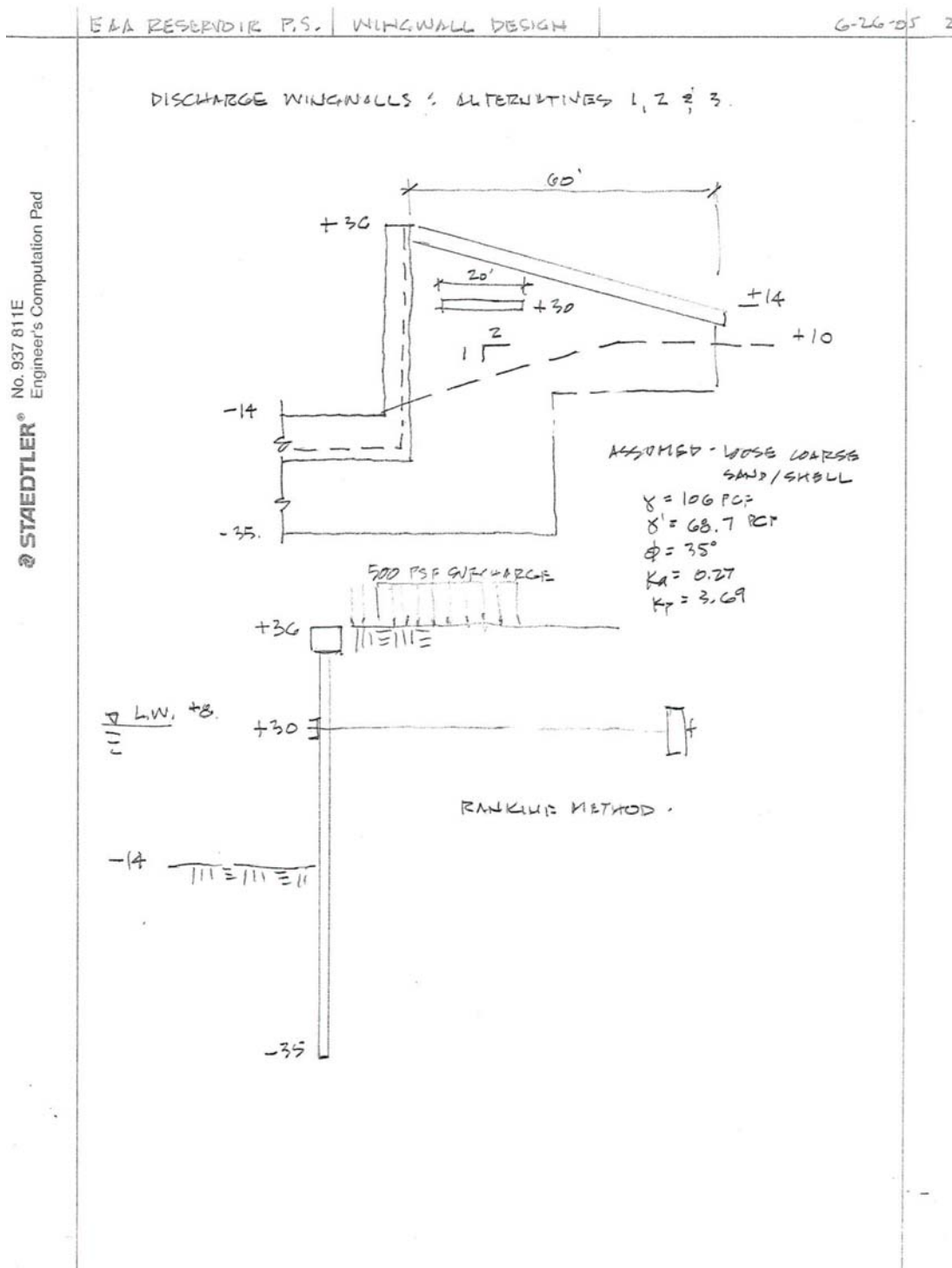


South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005







STAEDTLER®
 No. 937 811E
 Engineer's Computation Pad

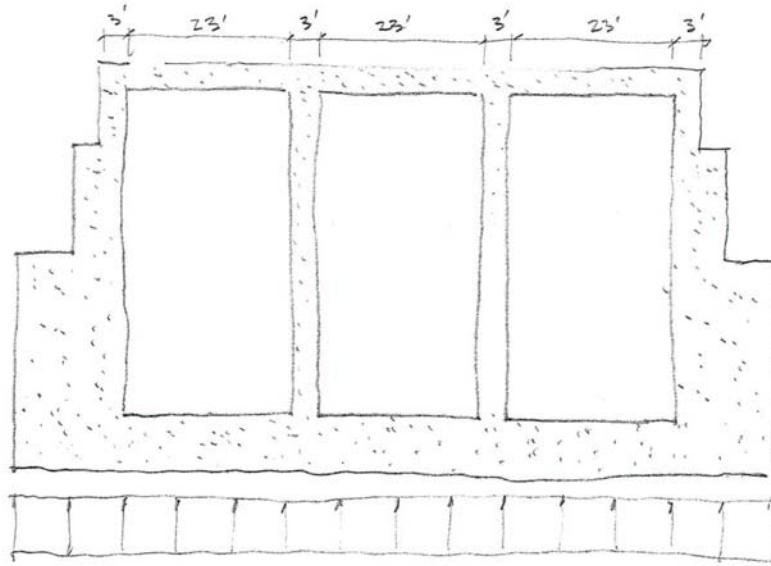
EAA RESERVOIR FS

STRUCTURAL DESIGN

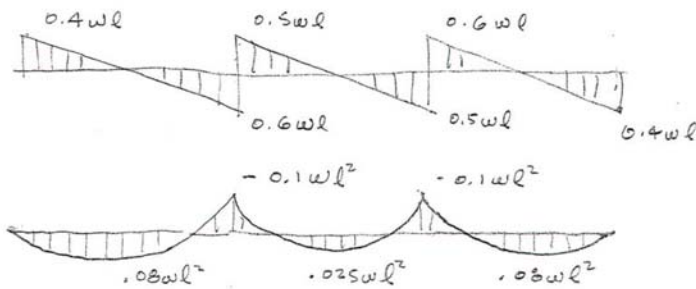
6-26-05 6

BASE SLAB: CONSTRUCTION CONDITION, STRUCTURE IN THE DRY,
RIGID MAT, LINEAR DISTRIBUTION OF LOAD.

ALTERNATIVE No. 1 REVIEWED SINCE IT HAS GREATEST BEARING LOAD.



$$D.L. \quad 2.25 \text{ K/ft} \times 1.4 = 2.835 \text{ K/ft}$$



$$- 0.1wl^2 = 0.1 (2.835)(26)^2 = 191.6 \text{ K-ft}$$

$$+ 0.08wl^2 = 0.08 (2.835)(26)^2 = 153.3 \text{ K-ft}$$

FOR BALANCED DESIGN MIN σ $d = 30$ $b = 24$ (2) #11 / ft

TOP & BOTTOM

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

COST ESTIMATES

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA RESERVOIR PUMP STATION			ALTERNATIVE No. 1		
(3) 1000 cfs Vertical Pumps w/ FSI			7/2/2005		
Item Description	Unit	Quantity	Unit Cost	Total	
OVERHEAD					
Bonds	LS	job	\$ 130,000	\$	130,000
Builders Risk	LS	job	\$ 70,000	\$	70,000
Licenses	LS	job	\$ 10,000	\$	10,000
Insurance	LS	job	\$ 100,000	\$	100,000
Owner's Offices	mn	24	\$ 4,000	\$	96,000
Contractor's Offices	mn	24	\$ 4,000	\$	96,000
Utilities	mn	24	\$ 3,000	\$	72,000
Quality Control Testing	LS	job	\$ 80,000	\$	80,000
Engineering Consultant	LS	job	\$ 50,000	\$	50,000
Scheduling Consultant	mn	24	\$ 3,500	\$	84,000
Administration Staff	mn	24	\$ 40,000	\$	960,000
Field Engineering and Survey	LS	job	\$ 60,000	\$	60,000
Subtotal				\$	1,808,000
DEWATERING					
1 Cofferdam 150 ft. x 100 ft., install and remove					
el. +14 to -36, 50 ft./PZ35 sht.	ton	438	\$ 1,600	\$	700,800
Bracing and tie-back system	LS	job	\$ 300,000	\$	300,000
Pumping	mn	9	\$ 10,000	\$	90,000
Detention Basin	LS	job	\$ 20,000	\$	20,000
2 Excavation	cy	25000	\$ 5	\$	125,000
Subtotal				\$	1,235,800
STRUCTURE (Installed costs UON)					
1 Reinforced Concrete w/ Embeds					
Intake Base Slab	cy	2097	\$ 400	\$	838,800
Intake Abutments	cy	1223	\$ 400	\$	489,200
FSI to Operating Floor	cy	2822	\$ 600	\$	1,693,200
Pump Embeds	LS	job	\$ 15,000	\$	15,000
Intake Piers	cy	1933	\$ 400	\$	773,200
Service Bridge	cy	82	\$ 500	\$	41,000
Approach Slabs	cy	60	\$ 400	\$	24,000
Fl'r Slab Embeds/Cover Plates	LS	job	\$ 20,000	\$	20,000
Operating Floor Slab Beams	cy	60	\$ 500	\$	30,000
Discharge Tunnel to Oper. Fl'r.	cy	2446	\$ 600	\$	1,467,600
Intake Noses	cy	20	\$ 600	\$	12,000
Tank Slab	cy	40	\$ 400	\$	16,000
Exterior Fuel Trench w/ cover	LS	job	\$ 15,000	\$	15,000
Service water intake	cy	140	\$ 500	\$	70,000
Interior fuel trench w/ grating	LS	job	\$ 7,000	\$	7,000
Bulkhead Slot Embeds	LS	job	\$ 25,000	\$	25,000
Gates Slot/Sill Embeds	LS	job	\$ 30,000	\$	30,000
Pump Support Ring	LS	job	\$ 15,000	\$	15,000
Miscel. Access ladders	ea	2	\$ 3,500	\$	7,000

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

	Pipe Gallery Hatches	LS	job	\$	3,000	\$	3,000
	Equipment Slabs	cy	25	\$	500	\$	12,500
	Total		10950				
2	Pump House 80 ft. x 95 ft. w/ 46 ft. parapet height						
	Precast Panel w/ embeds	sf	16100	\$	23	\$	370,300
	Steel Frame	LS	job	\$	140,000	\$	140,000
	Bridge Crane haunches/girders	LS	job	\$	30,000	\$	30,000
	Double Tee Precast Roof	sf	7600	\$	25	\$	190,000
	Roof Covering	sq	76	\$	500	\$	38,000
	Miscel. Sealants, etc	LS	job	\$	15,000	\$	15,000
	Control Rm. Slab/Walls/Beams	cy	105	\$	550	\$	57,750
	Control Rm. Stairs	LS	job	\$	3,500	\$	3,500
	Wheel chair lift	ea	1	\$	20,000	\$	20,000
	Control Rm. Viewing Windows	LS	job	\$	8,000	\$	8,000
	Restroom Fixtures	LS	job	\$	4,500	\$	4,500
	Break Room Fixtures	LS	job	\$	5,000	\$	5,000
	Counters, cabinets	LS	job	\$	8,500	\$	8,500
	Overhead doors w/ storm bars	ea	2	\$	13,000	\$	26,000
	Doors and hardware	ea	6	\$	3,500	\$	21,000
	Interior drywall, flooring etc.	LS	job	\$	10,000	\$	7,500
	Specialties, i.e. lockers	LS	job	\$	15,000	\$	15,000
	Access manway	ea	3	\$	4,500	\$	13,500
	Ladder w/ roof hatch	ea	1	\$	10,000	\$	10,000
4	Miscellaneous						
	Grating, embeds, steel support	sf	700	\$	45	\$	31,500
	Miscel. Embeds	LS	job	\$	10,000	\$	10,000
	Handrail	lf	150	\$	35	\$	5,250
5	Trash Rack						
	Rack, 42 x 23 sst	ea	3	\$	65,000	\$	195,000
	Supports and Embeds	ea	3	\$	25,000	\$	75,000
	Rack 10 x 12 service water	ea	1	\$	20,000	\$	20,000
6	Coatings						
	Exterior exposed concrete	LS	job	\$	27,000	\$	27,000
	Interior exposed concrete	LS	job	\$	25,000	\$	25,000
	Piping	LS	job	\$	22,000	\$	22,000
	Miscel. Metal	LS	job	\$	7,000	\$	7,000
	Subtotal					\$	7,005,800
MECHANICAL (Installed costs UON)							
1	Pumps						
	Axial Flow, 1000 cfs, 120"	ea	3	\$	1,325,000	\$	3,975,000
	Structural Support and Grating	ea	3	\$	60,000	\$	180,000
2	Reduction Gear						
	Lube Oil Cooling System	ea	3	\$	15,000	\$	45,000
3	Diesel Engine						
	Drive Shafts and Couplings	ea	3	\$	550,000	\$	1,650,000
	Flex coupling	ea	3	\$	25,000	\$	75,000
	Exhaust System	ea	3	\$	20,000	\$	60,000
4	Exhaust System						
	Silencer and supports	ea	3	\$	30,000	\$	90,000
	Piping & insulation	ea	3	\$	35,000	\$	105,000
	Supports	ea	3	\$	10,000	\$	30,000
5	Dewatering Gates						

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	10' x 23' sst Roller Gate	ea	3	\$	155,000	\$	465,000
	Electric Operator	ea	3	\$	65,000	\$	195,000
	Dewatering Bulkheads 23' x 12'	ea	3	\$	120,000	\$	360,000
6	Cooling Water System	ea	3	\$	6,500	\$	19,500
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	60,000	\$	60,000
	Strainers and Filters	ea	3	\$	10,000	\$	30,000
7	Service Water System						
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Filtration System	LS	job	\$	10,000	\$	10,000
8	Potable Water System						
	Water Softener	ea	1	\$	15,000	\$	15,000
	Piping, valves, fittings	LS	job	\$	20,000	\$	20,000
	Reverse Osmosis	ea	1	\$	45,000	\$	45,000
	Pneumatic Tank	ea	1	\$	6,500	\$	6,500
	Ultraviolet Unit	ea	1	\$	4,000	\$	4,000
9	Pump Lube Water System						
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Backwash filters	LS	job	\$	25,000	\$	25,000
10	Compressed Air System						
	Compressor 30 Hp	ea	1	\$	8,000	\$	8,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
	Air receivers	ea	3	\$	4,000	\$	12,000
	Filters	LS	job	\$	2,000	\$	2,000
11	Vacuum System						
	Pumps	ea	2	\$	25,000	\$	50,000
	Piping, valves, gages	LS	job	\$	120,000	\$	120,000
12	Fuel System						
	Engineering	LS	job	\$	35,000	\$	35,000
	Permits	LS	job	\$	10,000	\$	10,000
	Day Tanks	ea	3	\$	15,000	\$	45,000
	Storage Tanks - 20,000 gal.	ea	3	\$	100,000	\$	300,000
	Fuel Monitors and Instr.	LS	job	\$	60,000	\$	60,000
	Waste Fuel Tank 1000 gal.	ea	1	\$	7,500	\$	7,500
	Fuel Piping, Fittings, Filters	LS	job	\$	150,000	\$	150,000
	Transfer Pumps	ea	2	\$	7,500	\$	15,000
13	Lube Oil System						
	Storage Tank - 1,000 gal.	ea	1	\$	7,500	\$	7,500
	Transfer Pumps	ea	2	\$	3,500	\$	7,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
14	Waste Lube Oil System						
	Waste Fuel Tank 300 gal.	ea	1	\$	4,000	\$	4,000
	Transfer Pump	ea	1	\$	3,500	\$	3,500
	Piping, fittings, valves	LS	job	\$	20,000	\$	20,000
15	Sanitary Waste System						
	Collection piping	LS	job	\$	5,000	\$	5,000
	Lift station	LS	job	\$	7,500	\$	7,500
	Septic Tank 1000 gal.	LS	job	\$	2,500	\$	2,500
	Drain Field	LS	job	\$	2,500	\$	2,500
16	Trash Rake						
	Supports	LS	job	\$	80,000	\$	80,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Monorail	lf	200	\$	350	\$	70,000
	Containment Area	ea	2	\$	20,000	\$	40,000
	Trolley	ea	2	\$	45,000	\$	90,000
	Gripper	ea	2	\$	25,000	\$	50,000
17	Bridge Crane						
	Bridge Crane and Trolley	LS	job	\$	150,000	\$	150,000
18	Discharge Piping						
	Elbow, flanged 90 degree	ea	3	\$	45,000	\$	135,000
	Wall thimbles, rect. section	ea	3	\$	25,000	\$	75,000
	Subtotal					\$	9,789,000

HVAC (Installed costs UON)

1	Control Room A/C	LS	job	\$	30,000	\$	30,000
	Break Room A/C	LS	job	\$	20,000	\$	20,000
	Duct work/grilles/etc.	LS	job	\$	20,000	\$	20,000
2	Ventilation Fans						
	Equipment, installed	ea	6	\$	5,500	\$	33,000
	Intake Roll Filters	ea	3	\$	5,500	\$	16,500
	Hoods	ea	6	\$	3,500	\$	21,000
3	Miscel. Vents and Fans	LS	job	\$	10,000	\$	10,000
4	Controls	LS	job	\$	7,500	\$	7,500
	Subtotal					\$	158,000

ELECTRICAL (installed costs UON)

1	Power Distribution						
	Panelboards	LS	job	\$	150,000	\$	150,000
	Entrance, disconnects, etc.	LS	job	\$	50,000	\$	50,000
	Building distribution						
	Slab rough-in	LS	job	\$	120,000	\$	120,000
	Feeder rough-in	LS	job	\$	150,000	\$	150,000
	Branch Circuits	LS	job	\$	200,000	\$	200,000
	Grounding	LS	job	\$	35,000	\$	35,000
2	Emergency Power						
	Generator, 300kw	ea	2	\$	120,000	\$	240,000
	Transfer switch/controls	ea	2	\$	45,000	\$	90,000
	Wiring, boxes	LS	job	\$	80,000	\$	80,000
3	Lighting						
	Exterior	LS	job	\$	15,000	\$	15,000
	Interior	LS	job	\$	25,000	\$	25,000
	Emergency	LS	job	\$	7,500	\$	7,500
4	Lightning Protection System	LS	job	\$	25,000	\$	25,000
5	Security System	LS	job	\$	15,000	\$	15,000
	Subtotal					\$	1,202,500

CONTROL AND COMMUNICATIONS

1	Engine Control Center						
	PLC, software, etc.	ea	3	\$	50,000	\$	150,000
	Conversion Modules	ea	3	\$	10,000	\$	30,000
	I/O instrumentation	ea	3	\$	20,000	\$	60,000
	Programming	LS	job	\$	10,000	\$	10,000
	Auxiliary interface systems	ea	3	\$	15,000	\$	45,000
	Cabinet, wiring, relays, etc.	ea	3	\$	65,000	\$	195,000

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

2	Primary Console					
	SCADA Nodes	ea	3	\$	10,000	\$ 30,000
	Workstation Module	ea	1	\$	25,000	\$ 25,000
	Notebook Computers	ea	1	\$	7,000	\$ 7,000
	Main PLC Control Panel	ea	1	\$	75,000	\$ 75,000
	Remote I/O Panels	LS	job	\$	45,000	\$ 45,000
	Intellution Software	LS	job	\$	28,000	\$ 28,000
	Programming	LS	job	\$	30,000	\$ 30,000
3	Instrumentation					
	Ultrasonic level transmitters	ea	10	\$	4,500	\$ 45,000
	Level switches	ea	10	\$	3,500	\$ 35,000
	Flow switches	ea	9	\$	1,500	\$ 13,500
	Pressure transmitters	ea	3	\$	5,000	\$ 15,000
	Pressure switches	ea	6	\$	1,200	\$ 7,200
4	UPS and Surge Protection	LS	job	\$	20,000	\$ 20,000
5	Antenna and transmitter	ea	1	\$	30,000	\$ 30,000
6	Engineering Services	LS	job	\$	30,000	\$ 30,000
	TOTAL					\$ 925,700

SITE WORK

1	Intake Basin					
	Clearing	LS	job	\$	5,000	\$ 5,000
	Stone Protection	cy	3900	\$	80	\$ 312,000
	Excavation	cy	33000	\$	5	\$ 165,000
2	Discharge Channel					
	Excavation	cy	20800	\$	5	\$ 104,000
	Stone Protection	cy	3600	\$	80	\$ 288,000
3	Wingwalls and Cutoff Walls					
	Sheet pile, installed	tn	300	\$	2,000	\$ 600,000
	Cap, Reinforced Concrete	lf	240	\$	120	\$ 28,800
	Tie-back	ea	4	\$	55,000	\$ 220,000
	Backfill, granular	cy	5000	\$	7	\$ 35,000
	Handrail	lf	240	\$	35	\$ 8,400
4	Station Site					
	Asphalt w/ Limerock Base	sy	2000	\$	15	\$ 30,000
	Safety Barrier	LS	job	\$	20,000	\$ 20,000
	Weed Barrier	LS	job	\$	15,000	\$ 15,000
	Security Fence	lf	800	\$	10	\$ 8,000
	Security Gates	ea	4	\$	350	\$ 1,400
	Site fill from local borrow	cy	20000	\$	5	\$ 100,000
5	Staff Gages	ea	2	\$	750	\$ 1,500
6	Platforms w/ stilling wells	ea	2	\$	90,000	\$ 180,000
7	Access Roads and Ramps					
	Embankment Fill (borrow)	cy	7500	\$	5	\$ 37,500
	Limerock Base	sy	5500	\$	9	\$ 49,500
	Guardrail	lf	500	\$	22	\$ 11,000
	Grading, Miscellaneous	LS	job	\$	25,000	\$ 25,000
8	Grassing/Sodding	LS	job	\$	10,000	\$ 10,000
	Subtotal					\$ 2,255,100
	SUBTOTAL					\$ 24,424,900
	20% Contingency					\$ 4,884,980
	TOTAL					\$ 29,309,880

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA RESERVOIR A-1 PUMP STATION**ALTERNATIVE No. 2****(3) 1000 cfs Horizontal Pumps**

7/2/2005

Item Description	Unit	Quantity	Unit Cost	Total
OVERHEAD				
Bonds	LS	job	\$ 130,000	\$ 130,000
Builders Risk	LS	job	\$ 70,000	\$ 70,000
Licenses	LS	job	\$ 10,000	\$ 10,000
Insurance	LS	job	\$ 100,000	\$ 100,000
Owner's Offices	mn	24	\$ 4,000	\$ 96,000
Contractor's Offices	mn	24	\$ 4,000	\$ 96,000
Utilities	mn	24	\$ 3,000	\$ 72,000
Quality Control Testing	LS	job	\$ 80,000	\$ 80,000
Engineering Consultant	LS	job	\$ 50,000	\$ 50,000
Scheduling Consultant	mn	24	\$ 3,500	\$ 84,000
Administration Staff	mn	24	\$ 40,000	\$ 960,000
Field Engineering and Survey	LS	job	\$ 60,000	\$ 60,000
Subtotal				\$ 1,808,000
DEWATERING				
1 Cofferdam 200 ft. x 100 ft., install and remove				
el. +14 to -36, 50 ft./PZ35 sht.	ton	525	\$ 1,600	\$ 840,000
Bracing and tie-back system	LS	job	\$ 350,000	\$ 350,000
Pumping	mn	9	\$ 12,000	\$ 108,000
Detention Basin	LS	job	\$ 24,000	\$ 24,000
2 Excavation	cy	34000	\$ 5	\$ 170,000
Subtotal				\$ 1,492,000
STRUCTURE (Installed costs UON)				
1 Reinforced Concrete w/ embeds				
Base Slab	cy	2674	\$ 400	\$ 1,069,600
Abutments	cy	2079	\$ 400	\$ 831,600
FSI to Operating Floor	cy	2822	\$ 600	\$ 1,693,200
Pump Embeds	LS	job	\$ 7,000	\$ 7,000
Piers	cy	1422	\$ 400	\$ 568,800
Service Bridge	cy	102	\$ 500	\$ 51,000
Fl'r Slab Embeds/Cover Plates	LS	job	\$ 5,000	\$ 5,000
Operating floor slab w/ beam	cy	210	\$ 500	\$ 105,000
Discharge Tunnel to Oper. Fl'r.	cy	750	\$ 600	\$ 450,000
Intake Noses	cy	20	\$ 600	\$ 12,000
Service water intake	cy	140	\$ 500	\$ 70,000
Interior Fuel Trench w/ grating	LS	job	\$ 7,000	\$ 7,000
Tank Slab	cy	40	\$ 400	\$ 16,000
Exterior Fuel Trench w/ cover	LS	job	\$ 12,000	\$ 12,000
Bulkhead Slot Embeds	LS	job	\$ 15,000	\$ 15,000
Gates Slot/Sill Embeds	LS	job	\$ 30,000	\$ 30,000
Pump Supports	cy	37	\$ 500	\$ 18,500
Pump Support Ring	LS	job	\$ 15,000	\$ 15,000
Miscel. Access ladders	ea	2	\$ 3,500	\$ 7,000

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

	Pipe Gallery Hatches	LS	job	\$	3,000	\$	3,000
	Equipment Slabs	cy	25	\$	500	\$	12,500
	Total		10323				
2	Pump House 50 ft. x 140 ft. w/ 40 ft. parapet height						
	Precast Panel w/ embeds	sf	15200	\$	23	\$	349,600
	Steel Frame	LS	job	\$	135,000	\$	135,000
	Bridge Crane haunches/girders	LS	job	\$	30,000	\$	30,000
	Double Tee Precast Roof	sf	7000	\$	25	\$	175,000
	Roof Covering	sq	70	\$	500	\$	35,000
	Add. Floor slab w/ col. pads	cy	100	\$	400	\$	40,000
	Miscel. Sealants, etc	LS	job	\$	15,000	\$	15,000
	Control Rm. Slab/Walls/Beams	cy	105	\$	300	\$	31,500
	Control Rm. Stairs	LS	job	\$	3,500	\$	3,500
	Wheel chair lift	ea	1	\$	20,000	\$	20,000
	Control Rm. Viewing Windows	LS	job	\$	5,000	\$	5,000
	Restroom Fixtures	LS	job	\$	4,500	\$	4,500
	Ladder w/ roof hatch	ea	1	\$	10,000	\$	10,000
	Break Room Fixtures	LS	job	\$	5,000	\$	5,000
	Counters, cabinets	LS	job	\$	8,500	\$	8,500
	Overhead doors w/ storm bars	ea	2	\$	13,000	\$	26,000
	Doors and hardware	ea	6	\$	3,500	\$	21,000
	Interior drywall, flooring etc.	LS	job	\$	8,000	\$	7,500
	Specialties, i.e. lockers	LS	job	\$	15,000	\$	15,000
3	Miscellaneous						
	Grating, embeds, steel support	sf	700	\$	45	\$	31,500
	Miscel. Embeds	LS	job	\$	10,000	\$	10,000
	Handrail	lf	210	\$	35	\$	7,350
4	Trash Rack						
	Rack, 42 x 23 sst	ea	3	\$	65,000	\$	195,000
	Supports and Embeds	ea	3	\$	25,000	\$	75,000
	Rack 10 x 12 service water	ea	1	\$	20,000	\$	20,000
5	Coatings						
	Exterior exposed concrete	LS	job	\$	35,000	\$	35,000
	Interior exposed concrete	LS	job	\$	20,000	\$	20,000
	Piping	LS	job	\$	35,000	\$	35,000
	Miscel. Metal	LS	job	\$	7,000	\$	7,000
	Subtotal					\$	6,372,150

MECHANICAL (Installed costs UON)

1	Pumps						
	Axial Flow, 1000 cfs, 124"	ea	3	\$	1,425,000	\$	4,275,000
	Structural Support and Grating	ea	3	\$	20,000	\$	60,000
2	Reduction Gear	ea	3	\$	220,000	\$	660,000
	Lube Oil Cooling System	ea	3	\$	15,000	\$	45,000
3	Diesel Engine	ea	3	\$	550,000	\$	1,650,000
	Drive Shafts and Couplings	ea	3	\$	35,000	\$	105,000
	Flex coupling	ea	3	\$	20,000	\$	60,000
4	Exhaust System						
	Silencer and supports	ea	3	\$	30,000	\$	90,000
	Piping & insulation	ea	3	\$	35,000	\$	105,000
	Supports	ea	3	\$	10,000	\$	30,000
5	Cooling Water System	ea	3	\$	6,500	\$	19,500

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	60,000	\$	60,000
	Strainers and Filters	ea	3	\$	10,000	\$	30,000
6	Service Water System						
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Filtration System	LS	job	\$	10,000	\$	10,000
7	Potable Water System						
	Water Softener	ea	1	\$	15,000	\$	15,000
	Piping, valves, fittings	LS	job	\$	20,000	\$	20,000
	Reverse Osmosis	ea	1	\$	45,000	\$	45,000
	Pneumatic Tank	ea	1	\$	6,500	\$	6,500
	Ultraviolet Unit	ea	1	\$	4,000	\$	4,000
8	Pump Lube Water System						
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Backwash filters	LS	job	\$	25,000	\$	25,000
7	Compressed Air System						
	Compressor 30 Hp	ea	1	\$	8,000	\$	8,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
	Air receivers	ea	3	\$	4,000	\$	12,000
	Filters	LS	job	\$	2,000	\$	2,000
8	Vacuum System						
	Pumps	ea	2	\$	35,000	\$	70,000
	Piping, valves, gages	LS	job	\$	130,000	\$	130,000
9	Fuel System						
	Engineering	LS	job	\$	35,000	\$	35,000
	Permits	LS	job	\$	10,000	\$	10,000
	Day Tanks	ea	3	\$	15,000	\$	45,000
	Storage Tanks - 20,000 gal.	ea	3	\$	100,000	\$	300,000
	Fuel Monitors and Instr.	LS	job	\$	60,000	\$	60,000
	Waste Fuel Tank 1000 gal.	ea	1	\$	7,500	\$	7,500
	Fuel Piping, Fittings, Filters	LS	job	\$	150,000	\$	150,000
	Transfer Pumps	ea	2	\$	7,500	\$	15,000
10	Lube Oil System						
	Storage Tanks - 1,000 gal.	ea	1	\$	7,500	\$	7,500
	Transfer Pumps	ea	2	\$	3,500	\$	7,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
11	Waste Lube Oil System						
	Waste Fuel Tank 300 gal.	ea	1	\$	4,000	\$	4,000
	Transfer Pump	ea	1	\$	3,500	\$	3,500
	Piping, fittings, valves	LS	job	\$	20,000	\$	20,000
12	Sanitary Waste System						
	Collection piping	LS	job	\$	5,000	\$	5,000
	Lift station	LS	job	\$	7,500	\$	7,500
	Septic Tank 1000 gal.	LS	job	\$	2,500	\$	2,500
	Drain Field	LS	job	\$	2,500	\$	2,500
13	Trash Rake						
	Supports	LS	job	\$	100,000	\$	100,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Monorail	lf	250	\$	350	\$	87,500
	Containment Area	ea	2	\$	20,000	\$	40,000
	Trolley	ea	2	\$	45,000	\$	90,000
	Gripper	ea	2	\$	25,000	\$	50,000
14	Dewatering Gates						
	14.5' x 23' sst Roller Gate	ea	3	\$	175,000	\$	525,000
	Electric Operator	ea	3	\$	65,000	\$	195,000
	Dewatering Bulkheads 23'x12'	ea	3	\$	120,000	\$	360,000
15	Bridge Crane						
	Bridge Crane and Trolley	LS	job	\$	110,000	\$	110,000
16	Discharge Piping						
	Pipe, steel, flanged	lf	40	\$	550	\$	22,000
	Elbow, flanged 90 degree	ea	3	\$	50,000	\$	150,000
	Elbow, flanged - 45 degree	ea	3	\$	25,000	\$	75,000
	Thrust Supports	LS	job	\$	5,000	\$	5,000
	Wall thimbles	ea	3	\$	25,000	\$	75,000
	Subtotal					\$	10,263,500

HVAC (Installed costs UON)

1	Control Room A/C	LS	job	\$	30,000	\$	30,000
	Break Room A/C	LS	job	\$	20,000	\$	20,000
	Duct work/grilles/etc.	LS	job	\$	20,000	\$	20,000
2	Ventilation Fans						
	Equipment, installed	ea	6	\$	5,500	\$	33,000
	Intake Roll Filters	ea	3	\$	5,500	\$	16,500
	Hoods	ea	6	\$	3,500	\$	21,000
3	Miscel. Vents and Fans	LS	job	\$	10,000	\$	10,000
4	Controls	LS	job	\$	7,500	\$	7,500
	Subtotal					\$	158,000

ELECTRICAL (installed costs UON)

1	Power Distribution						
	Panelboards	LS	job	\$	150,000	\$	150,000
	Entrance, disconnects, etc.	LS	job	\$	50,000	\$	50,000
	Building distribution						
	Slab rough-in	LS	job	\$	120,000	\$	120,000
	Feeder rough-in	LS	job	\$	150,000	\$	150,000
	Branch Circuits	LS	job	\$	200,000	\$	200,000
	Grounding	LS	job	\$	35,000	\$	35,000
2	Emergency Power						
	Generator, 300kw	ea	2	\$	120,000	\$	240,000
	Transfer switch/controls	ea	2	\$	45,000	\$	90,000
	Wiring, boxes	LS	job	\$	80,000	\$	80,000
3	Lighting						
	Exterior	LS	job	\$	15,000	\$	15,000
	Interior	LS	job	\$	20,000	\$	20,000
	Emergency	LS	job	\$	7,500	\$	7,500
4	Lightning Protection System	LS	job	\$	25,000	\$	25,000
5	Security System	LS	job	\$	15,000	\$	15,000
	Subtotal					\$	1,197,500

CONTROL AND COMMUNICATIONS

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

1	Engine Control Center					
	PLC, software, etc.	ea	3	\$ 50,000	\$	150,000
	Conversion Modules	ea	3	\$ 10,000	\$	30,000
	I/O instrumentation	ea	3	\$ 20,000	\$	60,000
	Programming	LS	job	\$ 10,000	\$	10,000
	Auxiliary interface systems	ea	3	\$ 15,000	\$	45,000
	Cabinet, wiring, relays, etc.	ea	3	\$ 65,000	\$	195,000
2	Primary Console					
	SCADA Nodes	ea	3	\$ 10,000	\$	30,000
	Workstation Module	ea	1	\$ 25,000	\$	25,000
	Notebook Computers	ea	1	\$ 7,000	\$	7,000
	Main PLC Control Panel	ea	1	\$ 75,000	\$	75,000
	Remote I/O Panels	LS	job	\$ 45,000	\$	45,000
	Itellution Software	LS	job	\$ 28,000	\$	28,000
	Programing	LS	job	\$ 30,000	\$	30,000
3	Instrumentation					
	Ultrasonic level transmitters	ea	10	\$ 4,500	\$	45,000
	Level switches	ea	10	\$ 3,500	\$	35,000
	Flow switches	ea	9	\$ 1,500	\$	13,500
	Pressure transmitters	ea	3	\$ 5,000	\$	15,000
	Pressure switches	ea	6	\$ 1,200	\$	7,200
4	UPS and Surge Protection	LS	job	\$ 20,000	\$	20,000
5	Antenna and transmitter	ea	1	\$ 30,000	\$	30,000
6	Engineering Services	LS	job	\$ 30,000	\$	30,000
	TOTAL				\$	925,700

SITE WORK

1	Intake Basin					
	Clearing	LS	job	\$ 5,000	\$	5,000
	Stone Protection	cy	3900	\$ 80	\$	312,000
	Excavation	cy	33000	\$ 5	\$	165,000
2	Discharge Channel					
	Excavation	cy	20800	\$ 5	\$	104,000
	Stone Protection	cy	3600	\$ 80	\$	288,000
3	Wingwalls and Cutoff Walls					
	Sheet pile, installed	tn	300	\$ 2,000	\$	600,000
	Cap, Reinforced Concrete	lf	240	\$ 120	\$	28,800
	Tie-back	ea	4	\$ 55,000	\$	220,000
	Backfill, granular	cy	5000	\$ 7	\$	35,000
	Handrail	lf	240	\$ 35	\$	8,400
4	Station Site					
	Asphalt w/ Limerock Base	sy	2000	\$ 15	\$	30,000
	Safety Barrier	LS	job	\$ 20,000	\$	20,000
	Weed Barrier	LS	job	\$ 15,000	\$	15,000
	Security Fence	lf	800	\$ 10	\$	8,000
	Security Gates	ea	4	\$ 350	\$	1,400
	Site fill from local borrow	cy	20000	\$ 5	\$	100,000
5	Staff Gages	ea	2	\$ 750	\$	1,500
6	Stilling Wells - Platform	ea	2	\$ 90,000	\$	180,000
7	Access Roads and Ramps					
	Embankment Fill (borrow)	cy	7500	\$ 5	\$	37,500
	Limerock Base	sy	5500	\$ 9	\$	49,500
	Guardrail	lf	500	\$ 22	\$	11,000
	Grading, Miscellaneous	LS	job	\$ 25,000	\$	25,000
8	Grassing/Sodding	LS	job	\$ 10,000	\$	10,000

Subtotal		\$	2,255,100
SUBTOTAL		\$	24,516,950
20% Contingency		\$	4,903,390
TOTAL		\$	29,420,340

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA RESERVOIR PUMP STATION**ALTERNATIVE No. 3A****(4) 750 cfs Vertical Pumps w/ FSI****7/2/2005**

Item Description	Unit	Quantity	Unit Cost	Total
OVERHEAD				
Bonds	LS	job	\$ 130,000	\$ 130,000
Builders Risk	LS	job	\$ 70,000	\$ 70,000
Licenses	LS	job	\$ 10,000	\$ 10,000
Insurance	LS	job	\$ 100,000	\$ 100,000
Owner's Offices	mn	24	\$ 4,000	\$ 96,000
Contractor's Offices	mn	24	\$ 4,000	\$ 96,000
Utilities	mn	24	\$ 3,000	\$ 72,000
Quality Control Testing	LS	job	\$ 80,000	\$ 80,000
Engineering Consultant	LS	job	\$ 50,000	\$ 50,000
Scheduling Consultant	mn	24	\$ 3,500	\$ 84,000
Administration Staff	mn	24	\$ 40,000	\$ 960,000
Field Engineering and Survey	LS	job	\$ 60,000	\$ 60,000
Subtotal				\$ 1,808,000

DEWATERING

1	Cofferdam 205 ft. x 105 ft., install and remove				
	el. +14 to -36, 50 ft./PZ35 sht.	ton	455	\$ 1,600	\$ 728,000
	Bracing and tie-back system	LS	job	\$ 325,000	\$ 325,000
	Pumping	mn	9	\$ 11,000	\$ 99,000
	Detention Basin	LS	job	\$ 20,000	\$ 20,000
2	Excavation	cy	25000	\$ 5	\$ 125,000
	Subtotal				\$ 1,297,000

STRUCTURE (Installed costs UON)

1	Reinforced Concrete w/ Embeds				
	Intake Base Slab	cy	2603	\$ 400	\$ 1,041,200
	Intake Abutments	cy	1985	\$ 400	\$ 794,000
	FSI to Operating Floor	cy	2010	\$ 600	\$ 1,206,000
	Pump Embeds	LS	job	\$ 14,000	\$ 14,000
	Intake Piers	cy	2304	\$ 400	\$ 921,600
	Service Bridge	cy	130	\$ 500	\$ 65,000
	Approach Slabs	cy	60	\$ 400	\$ 24,000
	Fl'r slab emb'ds/covers/support	ea	4	\$ 20,000	\$ 80,000
	Intake Noses	cy	20	\$ 600	\$ 12,000
	Tank Slab	cy	40	\$ 400	\$ 16,000
	Exterior Fuel Trench w/ cover	LS	job	\$ 15,000	\$ 15,000
	Service water intake	cy	140	\$ 500	\$ 70,000
	Interior fuel trench w/ grating	LS	job	\$ 7,000	\$ 7,000
	Bulkhead Slot Embeds	LS	job	\$ 25,000	\$ 25,000
	Gates Slot/Sill Embeds	ea	2	\$ 30,000	\$ 60,000
	Gate operating platform	cy	60	\$ 500	\$ 30,000
	Miscel. Embeds, grating	LS	job	\$ 4,500	\$ 4,500
	Pump Support Ring	LS	job	\$ 15,000	\$ 15,000
	Miscel. Access ladders	ea	2	\$ 3,500	\$ 7,000

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

	Pipe Gallery Hatches	LS	job	\$	3,000	\$	3,000
	Equipment Slabs	cy	30	\$	500	\$	15,000
	Total		9390				
2	Pump House 80 ft. x 93 ft. w/ 50 ft. parapet height						
	Precast Panel w/ embeds	sf	17300	\$	23	\$	397,900
	Steel Frame	LS	job	\$	140,000	\$	140,000
	Bridge Crane haunches/girders	LS	job	\$	30,000	\$	30,000
	Double Tee Precast Roof	sf	7440	\$	25	\$	186,000
	Roof Covering	sq	75	\$	500	\$	37,500
	Miscel. Sealants, etc	LS	job	\$	15,000	\$	15,000
	Control Rm. Slab/Walls/Beams	cy	135	\$	550	\$	74,250
	Control Rm. Stairs	LS	job	\$	3,500	\$	3,500
	Wheel chair lift	ea	1	\$	20,000	\$	20,000
	Control Rm. Viewing Windows	LS	job	\$	10,000	\$	10,000
	Restroom Fixtures	LS	job	\$	4,500	\$	4,500
	Break Room Fixtures	LS	job	\$	5,000	\$	5,000
	Counters, cabinets	LS	job	\$	8,500	\$	8,500
	Overhead doors w/ storm bars	ea	2	\$	13,000	\$	26,000
	Doors and hardware	ea	6	\$	3,500	\$	21,000
	Interior drywall, flooring etc.	LS	job	\$	10,000	\$	7,500
	Specialties, i.e. lockers	LS	job	\$	15,000	\$	15,000
	Access manway	ea	4	\$	4,500	\$	18,000
	Ladder w/ roof hatch	ea	1	\$	10,000	\$	10,000
4	Miscellaneous						
	Grating, embeds, steel support	sf	450	\$	45	\$	20,250
	Access ladders/platforms	LS	job	\$	3,500	\$	3,500
	Handrail	lf	200	\$	35	\$	7,000
5	Trash Rack						
	Rack, 38 x 19.5 sst	ea	4	\$	60,000	\$	240,000
	Supports and Embeds	ea	4	\$	22,000	\$	88,000
	Rack 10 x 12 service water	ea	1	\$	20,000	\$	20,000
6	Coatings						
	Exterior exposed concrete	LS	job	\$	29,000	\$	29,000
	Interior exposed concrete	LS	job	\$	27,000	\$	27,000
	Piping	LS	job	\$	24,000	\$	24,000
	Miscel. Metal	LS	job	\$	7,000	\$	7,000
	Subtotal					\$	5,920,700
MECHANICAL (Installed costs UON)							
1	Pumps						
	Axial Flow, 750 cfs, 102"	ea	4	\$	900,000	\$	3,600,000
2	Reduction Gear	ea	4	\$	110,000	\$	440,000
	Lube Oil Cooling System	ea	4	\$	13,000	\$	52,000
3	Diesel Engine	ea	4	\$	450,000	\$	1,800,000
	Drive Shafts and Couplings	ea	4	\$	21,000	\$	84,000
	Flex coupling	ea	4	\$	13,000	\$	52,000
4	Exhaust System						
	Silencer and supports	ea	4	\$	24,000	\$	96,000
	Piping & insulation	ea	4	\$	30,000	\$	120,000
	Supports	ea	4	\$	6,000	\$	24,000
5	Dewatering Gates						
	16' x 19.5' sst Roller Gate	ea	4	\$	165,000	\$	660,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Electric Operator	ea	4	\$	65,000	\$	260,000
6	Cooling Water System	ea	4	\$	6,500	\$	26,000
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	60,000	\$	60,000
	Strainers and Filters	ea	4	\$	8,000	\$	32,000
7	Service Water System						
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Filtration System	LS	job	\$	10,000	\$	10,000
8	Potable Water System						
	Water Softener	ea	1	\$	15,000	\$	15,000
	Piping, valves, fittings	LS	job	\$	20,000	\$	20,000
	Reverse Osmosis	ea	1	\$	45,000	\$	45,000
	Pneumatic Tank	ea	1	\$	6,500	\$	6,500
	Ultraviolet Unit	ea	1	\$	4,000	\$	4,000
9	Pump Lube Water System						
	Piping, valves and fittings	LS	job	\$	20,000	\$	20,000
	Backwash filters	LS	job	\$	25,000	\$	25,000
10	Compressed Air System						
	Compressor 30 Hp	ea	1	\$	8,000	\$	8,000
	Piping, fittings, valves	LS	job	\$	55,000	\$	55,000
	Air receivers	ea	4	\$	3,500	\$	14,000
	Filters	LS	job	\$	2,000	\$	2,000
11	Vacuum System						
	Pumps	ea	2	\$	2,300	\$	4,600
	Piping, valves, gages	LS	job	\$	130,000	\$	130,000
12	Fuel System						
	Engineering	LS	job	\$	35,000	\$	35,000
	Permits	LS	job	\$	10,000	\$	10,000
	Day Tanks	ea	4	\$	12,000	\$	48,000
	Storage Tanks - 20,000 gal.	ea	3	\$	100,000	\$	300,000
	Fuel Monitors and Instr.	LS	job	\$	60,000	\$	60,000
	Waste Fuel Tank 1000 gal.	ea	1	\$	7,500	\$	7,500
	Fuel Piping, Fittings, Filters	LS	job	\$	160,000	\$	160,000
	Transfer Pumps	ea	2	\$	7,500	\$	15,000
13	Lube Oil System						
	Storage Tank - 1,000 gal.	ea	1	\$	7,500	\$	7,500
	Transfer Pumps	ea	2	\$	3,500	\$	7,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
14	Waste Lube Oil System						
	Waste Fuel Tank 300 gal.	ea	1	\$	4,000	\$	4,000
	Transfer Pump	ea	1	\$	3,500	\$	3,500
	Piping, fittings, valves	LS	job	\$	20,000	\$	20,000
15	Sanitary Waste System						
	Collection piping	LS	job	\$	5,000	\$	5,000
	Lift station	LS	job	\$	7,500	\$	7,500
	Septic Tank 1000 gal.	LS	job	\$	2,500	\$	2,500
	Drain Field	LS	job	\$	2,500	\$	2,500
16	Trash Rake						
	Supports	LS	job	\$	80,000	\$	80,000
	Monorail	lf	200	\$	350	\$	70,000
	Containment Area	ea	2	\$	20,000	\$	40,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Trolley	ea	2	\$	45,000	\$	90,000
	Gripper	ea	2	\$	25,000	\$	50,000
17	Bridge Crane	LS	job	\$	150,000	\$	150,000
18	Backflow Prevention Gates						
	10' x 14' sst Roller Gate	ea	4	\$	125,000	\$	500,000
	Electric Operator	ea	4	\$	45,000	\$	180,000
	Dewatering Bulkhead 19.5'x12'	ea	3	\$	105,000	\$	315,000
19	Discharge Piping						
	102" steel pipe, flanged	lf	300	\$	250	\$	75,000
	Flex. Coupling	ea	4	\$	8,500	\$	34,000
	45 degree elbow	ea	4	\$	20,000	\$	80,000
	Pump discharge elbow	ea	4	\$	45,000	\$	180,000
	Wall thimbles, rect. section	ea	4	\$	20,000	\$	80,000
	Subtotal					\$	10,384,100

HVAC (Installed costs UON)

1	Control Room A/C	LS	job	\$	30,000	\$	30,000
	Break Room A/C	LS	job	\$	20,000	\$	20,000
	Duct work/grilles/etc.	LS	job	\$	20,000	\$	20,000
2	Ventilation Fans						
	Equipment, installed	ea	6	\$	5,500	\$	33,000
	Intake Roll Filters	ea	3	\$	5,500	\$	16,500
	Hoods	ea	6	\$	3,500	\$	21,000
3	Miscel. Vents and Fans	LS	job	\$	10,000	\$	10,000
4	Controls	LS	job	\$	7,500	\$	7,500
	Subtotal					\$	158,000

ELECTRICAL (installed costs UON)

1	Power Distribution						
	Panelboards	LS	job	\$	150,000	\$	150,000
	Entrance, disconnects, etc.	LS	job	\$	50,000	\$	50,000
	Building distribution						
	Slab rough-in	LS	job	\$	120,000	\$	120,000
	Feeder rough-in	LS	job	\$	150,000	\$	150,000
	Branch Circuits	LS	job	\$	200,000	\$	200,000
	Grounding	LS	job	\$	35,000	\$	35,000
2	Emergency Power						
	Generator, 300kw	ea	2	\$	120,000	\$	240,000
	Transfer switch/controls	ea	2	\$	45,000	\$	90,000
	Wiring, boxes	LS	job	\$	80,000	\$	80,000
3	Lighting						
	Exterior	LS	job	\$	15,000	\$	15,000
	Interior	LS	job	\$	25,000	\$	25,000
	Emergency	LS	job	\$	7,500	\$	7,500
4	Lightning Protection System	LS	job	\$	25,000	\$	25,000
5	Security System	LS	job	\$	15,000	\$	15,000
	Subtotal					\$	1,202,500

CONTROL AND COMMUNICATIONS

1	Engine Control Center						
	PLC, software, etc.	ea	4	\$	50,000	\$	200,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Conversion Modules	ea	4	\$	10,000	\$	40,000
	I/O instrumentation	ea	4	\$	20,000	\$	80,000
	Programming	LS	job	\$	10,000	\$	10,000
	Auxiliary interface systems	ea	4	\$	15,000	\$	60,000
	Cabinet, wiring, relays, etc.	ea	4	\$	65,000	\$	260,000
2	Primary Console						
	SCADA Nodes	ea	4	\$	10,000	\$	40,000
	Workstation Module	ea	1	\$	25,000	\$	25,000
	Notebook Computers	ea	1	\$	7,000	\$	7,000
	Main PLC Control Panel	ea	1	\$	75,000	\$	75,000
	Remote I/O Panels	LS	job	\$	45,000	\$	45,000
	Itellution Software	LS	job	\$	28,000	\$	28,000
	Programing	LS	job	\$	30,000	\$	30,000
3	Instrumentation						
	Ultrasonic level transmitters	ea	11	\$	4,500	\$	49,500
	Level switches	ea	11	\$	3,500	\$	38,500
	Flow switches	ea	10	\$	1,500	\$	15,000
	Pressure transmitters	ea	4	\$	5,000	\$	20,000
	Pressure switches	ea	7	\$	1,200	\$	8,400
4	UPS and Surge Protection	LS	job	\$	20,000	\$	20,000
5	Antenna and transmitter	ea	1	\$	30,000	\$	30,000
6	Engineering Services	LS	job	\$	30,000	\$	30,000
	TOTAL					\$	1,111,400

SITE WORK

1	Intake Basin						
	Clearing	LS	job	\$	5,000	\$	5,000
	Stone Protection	cy	3900	\$	80	\$	312,000
	Excavation	cy	33000	\$	5	\$	165,000
2	Discharge Channel						
	Excavation	cy	20800	\$	5	\$	104,000
	Stone Protection	cy	3600	\$	80	\$	288,000
3	Wingwalls and Cutoff Walls						
	Sheet pile, installed	tn	300	\$	2,000	\$	600,000
	Cap, Reinforced Concrete	lf	240	\$	120	\$	28,800
	Tie-back	ea	4	\$	55,000	\$	220,000
	Backfill, granular	cy	5000	\$	7	\$	35,000
	Handrail	lf	240	\$	35	\$	8,400
4	Station Site						
	Asphalt w/ Limerock Base	sy	2000	\$	15	\$	30,000
	Safety Barrier	LS	job	\$	20,000	\$	20,000
	Weed Barrier	LS	job	\$	15,000	\$	15,000
	Security Fence	lf	800	\$	10	\$	8,000
	Security Gates	ea	4	\$	350	\$	1,400
	Site fill from local borrow	cy	20000	\$	5	\$	100,000
5	Staff Gages	ea	2	\$	750	\$	1,500
6	Platforms w/ stilling wells	ea	2	\$	90,000	\$	180,000
7	Access Roads and Ramps						
	Embankment Fill (borrow)	cy	7500	\$	5	\$	37,500
	Limerock Base	sy	5500	\$	9	\$	49,500
	Guardrail	lf	500	\$	22	\$	11,000
	Grading, Miscellaneous	LS	job	\$	25,000	\$	25,000
8	Grassing/Sodding	LS	job	\$	10,000	\$	10,000
	Subtotal					\$	2,255,100

SUBTOTAL	\$	24,186,300
20% Contingency	\$	4,837,260
TOTAL	\$	29,023,560

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA RESERVOIR PUMP STATION ALTERNATIVE No. 4A
(5) 600 cfs Vertical Pumps w/ Rectangular Intake 7/2/2005

Item Description	Unit	Quantity	Unit Cost	Total
OVERHEAD				
Bonds	LS	job	\$ 130,000	\$ 130,000
Builders Risk	LS	job	\$ 70,000	\$ 70,000
Licenses	LS	job	\$ 10,000	\$ 10,000
Insurance	LS	job	\$ 100,000	\$ 100,000
Owner's Offices	mn	24	\$ 4,000	\$ 96,000
Contractor's Offices	mn	24	\$ 4,000	\$ 96,000
Utilities	mn	24	\$ 3,000	\$ 72,000
Quality Control Testing	LS	job	\$ 80,000	\$ 80,000
Engineering Consultant	LS	job	\$ 50,000	\$ 50,000
Scheduling Consultant	mn	24	\$ 3,500	\$ 84,000
Administration Staff	mn	24	\$ 40,000	\$ 960,000
Field Engineering and Survey	LS	job	\$ 60,000	\$ 60,000
Subtotal				\$ 1,808,000

DEWATERING

1	Cofferdam 145 ft. x 150 ft., install and remove el. +14 to -36, 50 ft./PZ35 sht.	ton	516	\$ 1,600	\$ 825,600
	Bracing and tie-back system	LS	job	\$ 345,000	\$ 345,000
	Pumping	mn	9	\$ 12,000	\$ 108,000
	Detention Basin	LS	job	\$ 20,000	\$ 20,000
2	Excavation	cy	25000	\$ 5	\$ 125,000
	Subtotal				\$ 1,423,600

STRUCTURE (Installed costs UON)

1	Reinforced Concrete w/ Embeds				
	Intake Base Slab	cy	2800	\$ 400	\$ 1,120,000
	Intake Abutments	cy	1621	\$ 400	\$ 648,400
	Breast wall/vert./horz.elements	cy	1098	\$ 500	\$ 549,000
	Pump Embeds	LS	job	\$ 15,000	\$ 15,000
	Intake Piers	cy	1958	\$ 400	\$ 783,200
	Service Bridge	cy	300	\$ 500	\$ 150,000
	Approach Slabs	cy	60	\$ 400	\$ 24,000
	F/r slab emb'ds/covers/support	ea	5	\$ 20,000	\$ 100,000
	Intake Noses	cy	26	\$ 600	\$ 15,600
	Tank Slab	cy	40	\$ 400	\$ 16,000
	Exterior Fuel Trench w/ cover	LS	job	\$ 15,000	\$ 15,000
	Service water intake	cy	140	\$ 500	\$ 70,000
	Interior fuel trench w/ grating	LS	job	\$ 7,500	\$ 7,500
	Bulkhead Slot Embeds	LS	job	\$ 25,000	\$ 25,000
	Gates Slot/Sill Embeds	ea	2	\$ 30,000	\$ 60,000
	Gate operating platform	cy	100	\$ 500	\$ 50,000
	Miscel. Embeds, grating	LS	job	\$ 4,500	\$ 4,500
	Pump Support Ring	ea	5	\$ 6,000	\$ 30,000
	Miscel. Access ladders	ea	2	\$ 3,500	\$ 7,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Pipe Gallery Hatches	LS	job	\$	3,000	\$	3,000
	Equipment Slabs	cy	32	\$	500	\$	16,000
	Total		8189				
2	Pump House 80 ft. x 135 ft. w/ 50 ft. parapet height						
	Precast Panel w/ embeds	sf	21500	\$	23	\$	494,500
	Steel Frame	LS	job	\$	170,000	\$	170,000
	Bridge Crane haunches/girders	LS	job	\$	45,000	\$	45,000
	Double Tee Precast Roof	sf	10800	\$	25	\$	270,000
	Roof Covering	sq	108	\$	500	\$	54,000
	Miscel. Sealants, etc	LS	job	\$	17,000	\$	17,000
	Control Rm. Slab/Walls/Beams	cy	135	\$	550	\$	74,250
	Control Rm. Stairs	LS	job	\$	3,500	\$	3,500
	Wheel chair lift	ea	1	\$	20,000	\$	20,000
	Control Rm. Viewing Windows	LS	job	\$	10,000	\$	10,000
	Restroom Fixtures	LS	job	\$	4,500	\$	4,500
	Break Room Fixtures	LS	job	\$	5,000	\$	5,000
	Counters, cabinets	LS	job	\$	8,500	\$	8,500
	Overhead doors w/ storm bars	ea	2	\$	13,000	\$	26,000
	Doors and hardware	ea	6	\$	3,500	\$	21,000
	Interior drywall, flooring etc.	LS	job	\$	10,000	\$	7,500
	Specialties, i.e. lockers	LS	job	\$	15,000	\$	15,000
	Ladder w/ roof hatch	ea	1	\$	10,000	\$	10,000
4	Miscellaneous						
	Grating, embeds, steel support	sf	450	\$	45	\$	20,250
	Access ladders/platforms	LS	job	\$	3,500	\$	3,500
	Handrail	lf	350	\$	35	\$	12,250
5	Trash Rack						
	Rack, 40 x 23.5 sst	ea	5	\$	65,000	\$	325,000
	Supports and Embeds	ea	5	\$	22,000	\$	110,000
	Rack 10 x 12 service water	ea	1	\$	20,000	\$	20,000
6	Coatings						
	Exterior exposed concrete	LS	job	\$	35,000	\$	35,000
	Interior exposed concrete	LS	job	\$	30,000	\$	30,000
	Piping	LS	job	\$	26,000	\$	26,000
	Miscel. Metal	LS	job	\$	8,000	\$	8,000
	Subtotal					\$	5,554,950

MECHANICAL (Installed costs UON)

1	Pumps						
	Axial Flow, 600 cfs, 90"	ea	5	\$	700,000	\$	3,500,000
2	Reduction Gear	ea	5	\$	80,000	\$	400,000
	Lube Oil Cooling System	ea	5	\$	10,000	\$	50,000
3	Diesel Engine	ea	5	\$	350,000	\$	1,750,000
	Drive Shafts and Couplings	ea	5	\$	17,000	\$	85,000
	Flex coupling	ea	5	\$	12,000	\$	60,000
4	Exhaust System						
	Silencer and supports	ea	5	\$	20,000	\$	100,000
	Piping & insulation	ea	5	\$	23,000	\$	115,000
	Supports	ea	5	\$	4,000	\$	20,000
5	Dewatering Gates						
	16' x 23.5' sst Roller Gate	ea	5	\$	185,000	\$	925,000
	Electric Operator	ea	5	\$	70,000	\$	350,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Deatering Bulkhead 24'x12'	ea	3	\$	122,000	\$	366,000
6	Cooling Water System						
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	70,000	\$	70,000
	Strainers and Filters	ea	5	\$	8,000	\$	40,000
7	Service Water System						
	Pump - vert. turbine 30 Hp	ea	1	\$	20,000	\$	20,000
	Piping, valves and fittings	LS	job	\$	15,000	\$	15,000
	Filtration System	LS	job	\$	10,000	\$	10,000
8	Potable Water System						
	Water Softener	ea	1	\$	15,000	\$	15,000
	Piping, valves, fittings	LS	job	\$	20,000	\$	20,000
	Reverse Osmosis	ea	1	\$	45,000	\$	45,000
	Pneumatic Tank	ea	1	\$	6,500	\$	6,500
	Ultraviolet Unit	ea	1	\$	4,000	\$	4,000
9	Pump Lube Water System						
	Piping, valves and fittings	LS	job	\$	25,000	\$	25,000
	Backwash filters	LS	job	\$	25,000	\$	25,000
10	Compressed Air System						
	Compressor 5 Hp	ea	1	\$	1,500	\$	1,500
	Piping, fittings, valves	LS	job	\$	2,000	\$	2,000
11	Fuel System						
	Engineering	LS	job	\$	35,000	\$	35,000
	Permits	LS	job	\$	10,000	\$	10,000
	Day Tanks	ea	5	\$	9,000	\$	45,000
	Storage Tanks - 20,000 gal.	ea	3	\$	100,000	\$	300,000
	Fuel Monitors and Instr.	LS	job	\$	65,000	\$	65,000
	Waste Fuel Tank 1000 gal.	ea	1	\$	7,500	\$	7,500
	Fuel Piping, Fittings, Filters	LS	job	\$	160,000	\$	160,000
	Transfer Pumps	ea	2	\$	7,500	\$	15,000
12	Lube Oil System						
	Storage Tank - 1,000 gal.	ea	1	\$	7,500	\$	7,500
	Transfer Pumps	ea	2	\$	3,500	\$	7,000
	Piping, fittings, valves	LS	job	\$	45,000	\$	45,000
13	Waste Lube Oil System						
	Waste Fuel Tank 300 gal.	ea	1	\$	4,000	\$	4,000
	Transfer Pump	ea	1	\$	3,500	\$	3,500
	Piping, fittings, valves	LS	job	\$	20,000	\$	20,000
14	Sanitary Waste System						
	Collection piping	LS	job	\$	5,000	\$	5,000
	Lift station	LS	job	\$	7,500	\$	7,500
	Septic Tank 1000 gal.	LS	job	\$	2,500	\$	2,500
	Drain Field	LS	job	\$	2,500	\$	2,500
15	Trash Rake						
	Supports	LS	job	\$	80,000	\$	80,000
	Monorail	lf	250	\$	350	\$	87,500
	Containment Area	ea	2	\$	20,000	\$	40,000
	Trolley	ea	2	\$	45,000	\$	90,000
	Gripper	ea	2	\$	25,000	\$	50,000
17	Bridge Crane						
	Bridge Crane and Trolley	LS	job	\$	150,000	\$	150,000
18	Backflow Prevention Gates						

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

	10' x 14' sst Roller Gate	ea	5	\$	125,000	\$	625,000
	Electric Operator	ea	5	\$	45,000	\$	225,000
19	Discharge Piping						
	90" steel pipe, flanged	lf	100	\$	250	\$	25,000
	Flex. Coupling	ea	5	\$	8,500	\$	42,500
	Pump discharge elbow	ea	5	\$	45,000	\$	225,000
	Wall thimbles, rect. section	ea	5	\$	20,000	\$	100,000
	Subtotal					\$	10,522,000

HVAC (Installed costs UON)							
1	Control Room A/C	LS	job	\$	30,000	\$	30,000
	Break Room A/C	LS	job	\$	20,000	\$	20,000
	Duct work/grilles/etc.	LS	job	\$	20,000	\$	20,000
2	Ventilation Fans						
	Equipment, installed	ea	6	\$	5,500	\$	33,000
	Intake Roll Filters	ea	3	\$	5,500	\$	16,500
	Hoods	ea	6	\$	3,500	\$	21,000
3	Miscel. Vents and Fans	LS	job	\$	10,000	\$	10,000
4	Controls	LS	job	\$	7,500	\$	7,500
	Subtotal					\$	158,000

ELECTRICAL (installed costs UON)							
1	Power Distribution						
	Panelboards	LS	job	\$	150,000	\$	150,000
	Entrance, disconnects, etc.	LS	job	\$	50,000	\$	50,000
	Building distribution						
	Slab rough-in	LS	job	\$	120,000	\$	120,000
	Feeder rough-in	LS	job	\$	150,000	\$	150,000
	Branch Circuits	LS	job	\$	200,000	\$	200,000
	Grounding	LS	job	\$	35,000	\$	35,000
2	Emergency Power						
	Generator, 300kw	ea	2	\$	120,000	\$	240,000
	Transfer switch/controls	ea	2	\$	45,000	\$	90,000
	Wiring, boxes	LS	job	\$	80,000	\$	80,000
3	Lighting						
	Exterior	LS	job	\$	15,000	\$	15,000
	Interior	LS	job	\$	25,000	\$	25,000
	Emergency	LS	job	\$	7,500	\$	7,500
4	Lightning Protection System	LS	job	\$	25,000	\$	25,000
5	Security System	LS	job	\$	15,000	\$	15,000
	Subtotal					\$	1,202,500

CONTROL AND COMMUNICATIONS							
1	Engine Control Center						
	PLC, software, etc.	ea	5	\$	50,000	\$	250,000
	Conversion Modules	ea	5	\$	10,000	\$	50,000
	I/O instrumentation	ea	5	\$	20,000	\$	100,000
	Programming	LS	job	\$	10,000	\$	10,000
	Auxiliary interface systems	ea	5	\$	15,000	\$	75,000
	Cabinet, wiring, relays, etc.	ea	5	\$	65,000	\$	325,000
2	Primary Console						
	SCADA Nodes	ea	5	\$	10,000	\$	50,000
	Workstation Module	ea	1	\$	25,000	\$	25,000

BLACK & VEATCH

South Florida Water Management District EAA Reservoir A-1 Basis of Design Report

July, 2005

	Notebook Computers	ea	1	\$	7,000	\$	7,000
	Main PLC Control Panel	ea	1	\$	75,000	\$	75,000
	Remote I/O Panels	LS	job	\$	45,000	\$	45,000
	Itellution Software	LS	job	\$	28,000	\$	28,000
	Programing	LS	job	\$	30,000	\$	30,000
3	Instrumentation						
	Ultrasonic level transmitters	ea	12	\$	4,500	\$	54,000
	Level switches	ea	12	\$	3,500	\$	42,000
	Flow switches	ea	11	\$	1,500	\$	16,500
	Pressure transmitters	ea	5	\$	5,000	\$	25,000
	Pressure switches	ea	8	\$	1,200	\$	9,600
4	UPS and Surge Protection	LS	job	\$	20,000	\$	20,000
5	Antenna and transmitter	ea	1	\$	30,000	\$	30,000
6	Engineering Services	LS	job	\$	30,000	\$	30,000
	TOTAL					\$	1,297,100

SITE WORK

1	Intake Basin						
	Clearing	LS	job	\$	5,000	\$	5,000
	Stone Protection	cy	4985	\$	80	\$	398,800
	Excavation	cy	39700	\$	5	\$	198,500
2	Discharge Channel						
	Excavation	cy	24800	\$	5	\$	124,000
	Stone Protection	cy	4200	\$	80	\$	336,000
3	Wingwalls and Cutoff Walls						
	Sheet pile, installed	tn	300	\$	2,000	\$	600,000
	Cap, Reinforced Concrete	lf	240	\$	120	\$	28,800
	Tie-back	ea	4	\$	55,000	\$	220,000
	Backfill, granular	cy	5000	\$	7	\$	35,000
	Handrail	lf	240	\$	35	\$	8,400
4	Station Site						
	Asphalt w/ Limerock Base	sy	2000	\$	15	\$	30,000
	Safety Barrier	LS	job	\$	20,000	\$	20,000
	Weed Barrier	LS	job	\$	15,000	\$	15,000
	Security Fence	lf	800	\$	10	\$	8,000
	Security Gates	ea	4	\$	350	\$	1,400
	Site fill from local borrow	cy	20000	\$	5	\$	100,000
5	Staff Gages	ea	2	\$	750	\$	1,500
6	Platforms w/ stilling wells	ea	2	\$	90,000	\$	180,000
7	Access Roads and Ramps						
	Embankment Fill (borrow)	cy	7500	\$	5	\$	37,500
	Limerock Base	sy	5500	\$	9	\$	49,500
	Guardrail	lf	500	\$	22	\$	11,000
	Grading, Miscellaneous	LS	job	\$	25,000	\$	25,000
8	Grassing/Sodding	LS	job	\$	10,000	\$	10,000
	Subtotal					\$	2,443,400

SUBTOTAL \$ **24,463,550**

20% Contingency \$ **4,892,710**

TOTAL \$ **29,356,260**

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

LCC ANALYSIS

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EAA RESERVOIR A-1 PUMP STATION**LIFE CYCLE COST ANALYSIS**

n - number of years service	25
i - interest rate	6.00%
p - inflation rate	3.50%
Real Discount Rate	2.50%

ALTERNATIVE 1

Initial Investment Cost	\$29,309,880
Energy Cost/Year	\$ 924,290
Operating Cost per Year	\$ 278,875
Routine Maintenance per Year	\$ 32,111
Sum of Yearly Costs	\$ 1,235,276
Discount Factor for 25 Years	18.47
Present Value of Yearly Costs	\$22,815,548
Decommissioning Cost	\$ -
Cp/Cn Factor	0.58
Present Value of Final Year Costs	\$ -
Present LCC Value	\$52,125,428
Present LCC Operating Costs	\$ 5,150,821
Present LCC Energy	\$17,071,636
Present LCC Routine Maintenance	\$ 593,090

ALTERNATIVE 2

Initial Investment Cost	\$29,420,340
Energy Cost/Year	\$ 872,173
Operating Cost per Year	\$ 278,875
Routine Maintenance per Year	\$ 32,111
Sum of Yearly Costs	\$ 1,183,159
Discount Factor for 25 Years	18.47
Present Value of Yearly Costs	\$21,852,947
Decommissioning Cost	\$ 100,000
Cp/Cn Factor	0.58
Present Value of Final Year Costs	\$ 58,000
Present LCC Value	\$51,331,287
Present LCC Energy	\$16,109,035
Present LCC Operating Costs	\$ 5,150,821
Present LCC Routine Maintenance	\$ 593,090

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

ALTERNATIVE 3A

Initial Investment Cost	\$29,023,560
Energy Cost/Year	\$ 1,006,975
Operating Cost per Year	\$ 278,875
Routine Maintenance per Year	\$ 42,794
Sum of Yearly Costs	\$ 1,328,644
Discount Factor for 25 Years	18.47
Present Value of Yearly Costs	\$24,540,055
Decommissioning Cost	\$ 100,000
Cp/Cn Factor	0.58
Present Value of Final Year Costs	\$ 58,000
Present LCC Value	\$53,621,615
Present LCC Energy	\$18,598,828
Present LCC Operating Costs	\$ 5,150,821
Present LCC Routine Maintenance	\$ 790,405

ALTERNATIVE 4A

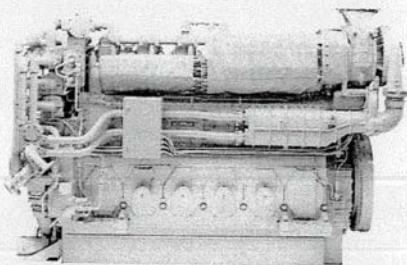
Initial Investment Cost	\$29,356,260
Energy Cost/Year	\$ 998,446
Operating Cost per Year	\$ 278,875
Routine Maintenance per Year	\$ 53,492
Sum of Yearly Costs	\$ 1,330,813
Discount Factor for 25 Years	18.47
Present Value of Yearly Costs	\$24,580,116
Decommissioning Cost	\$ 100,000
Cp/Cn Factor	0.58
Present Value of Final Year Costs	\$ 58,000
Present LCC Value	\$53,994,376
Present LCC Energy	\$18,441,298
Present LCC Operating Costs	\$ 5,150,821
Present LCC Routine Maintenance	\$ 987,997

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

EQUIPMENT/ENGINE DATA SHEETS

CATERPILLAR®Shown with
Accessory Equipment

Marine Propulsion Engine

3606

1730-2030 bkW (2320-2722 bhp) @ 900-1000 rpm

CATERPILLAR® ENGINE SPECIFICATIONS

In-Line 6, 4-Stroke-Cycle-Diesel

Emissions	IMO compliant
Bore — mm (in)	280 (11.0)
Stroke — mm (in)	300 (11.8)
Displacement — L (cu in)	111 (6,773)
Rotation (from flywheel end)	CCW or CW
Compression Ratio	13:1
Aspiration	Turbocharged-Aftercooled
Low Idle Speed — rpm	350
Rated Speed — rpm	900-1000
Average Piston Speed — m/s (ft/s)	9-10 (29.5-32.8)
Engine Firing Pressure —	
bar (psi)	162-173 (2,350-2,509)
BMEP — bar (psi)	22-22.9 (319-332)
BSFC — g/bkW-h (lb/hp-h)	197-206 (.324-.339)

PERFORMANCE DATA

Rated rpm	1000		900	
	bkW	bhp	bkW	bhp
Maximum Continuous	2030	2722	1900	2548
Continuous Service	1850	2481	1730	2320

STANDARD EQUIPMENT

Air Intake and Exhaust System

Charge air cooler, air inlet shutoff, high flow turbocharger, dry manifold with soft or hard shielding

Basic Engine Arrangement

In-line engine with one-piece grey iron cylinder block, individual cylinder heads with four intake/exhaust valves, right- or left-hand service side available

Cooling System

Single or combined system, engine mounted freshwater and seawater pumps, engine coolant water drains

Fuel System

Engine operates on MDO; fuel injection system is comprised of engine-driven fuel transfer pump and a unit injector for each cylinder, engine mounted duplex fuel filters, and flexible connections

Lube Oil System

Top-mounted crankcase breather, two centrifugal oil filters with single shutoff, gear-driven pump, duplex oil filter, crankcase explosion relief, oil filler and dipstick

Monitoring, Alarm, and Safety Control System

Alarms and shutdowns provided as required by marine society for unmanned machinery spaces. Marine Monitoring System II or Engine Control Panel are available; systems include temperature, pressure, and speed sensors; cylinder pressure relief valves, oil mist detector, and particle detector available

Speed Control

Electric actuator, programmable electronic governor, optional mechanical ballhead backup

General

Four lifting eyes mounted to cylinder heads, Caterpillar yellow paint, parts books and maintenance manuals, shrink wrap

Optional Supplied Equipment

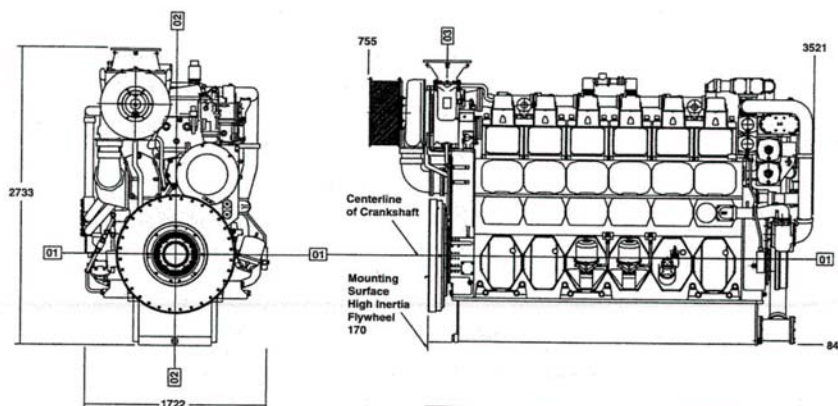
Torsional coupling, fresh water heat exchanger, fuel cooler, emergency pumps and connections, jacket water heater, flexible connections, and anti-vibration isolators

LEHM1876-01

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

CATERPILLAR® 3606 MARINE PROPULSION ENGINE — 1730-2030 bkW (2320-2722 bhp)



Engine	Overall Length mm (in)	Overall Width mm (in)	Overall Height mm (in)
3606	4276 (168)	1722 (68)	2733 (108)

Engine Weights	kg (lb)
Engine Dry Weight	15 680 (34,496)
Shipped Loose Items: Torsional Coupling	319 (702)
Plate-Type Heat Exchanger	400 (880)
Instrument/Alarm Panel	200 (440)
Fluids: Lube Oil	634 (1,395)
Jacket Water	400 (880)
Heat Exchanger (FW, SW, LO)	70 (154)

RATING DEFINITIONS AND CONDITIONS

MAXIMUM CONTINUOUS RATING – 8% of the engine operating hours at 100% of rated power, 92% of the engine operating hours at 90% of rated power.

CONTINUOUS SERVICE RATING – 100% of the engine operating hours at 100% of rated power.

RATINGS are based on SAE J1995/ISO3046 standard conditions of 100 kPa (29.61 in. Hg), 25°C (77°F), and 30% relative humidity at the stated charge air cooler water temperature. Ratings also meet classification society maximum temperature requirements of 45°C (113°F) air temperature to the turbocharger and 32°C (90°F) seawater temperature without derate.

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for additional information.

FUEL RATES are based on 35° API, 16°C (60°F) fuel used at 29°C (85°F) with a density of 838.9 g/liter (7.001 lbs/U.S. gal). Lower Heat Value (LHV) of 42 780 kJ/kg (18,390 Btu/lb). Tolerance is +5%. Includes all engine mounted pumps. BSFC without pumps is 3% less.

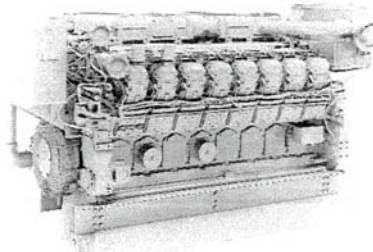
MARINE CERTIFICATION – Ratings are marine classification society approved by ABS, BV, CCS, DnV, GL, KR, LRS, NKK, RINA, and RS. These societies have also granted 3600 factory line production approval which eliminates requirement for society surveyor witness test.

Performance data is calculated in accordance with tolerances and conditions stated in this specification sheet and is only intended for purposes of comparison with other manufacturers' engines. Actual engine performance may vary according to the particular application of the engine and operating conditions beyond Caterpillar's control.

Materials and specifications are subject to change without notice.
LEHM1876-01 (4-02)

The International System of Units (SI) is used in this publication.
Printed in U.S.A.

©2002 Caterpillar
All rights reserved.

CATERPILLARShown with
Accessory Equipment**STANDARD EQUIPMENT****Air Inlet System**

Corrosion-resistant separate circuit aftercooler core (air side); regular duty air cleaner; dual turbochargers, 152 mm (6 in.) OD

Cooling System

Non-self-priming centrifugal auxiliary sea water pump, gear driven centrifugal jacket water pump, auxiliary fresh water pump, expansion tank, oil cooler, thermostats and housing with 92°C (198°F) full open temperature

Exhaust System

Dry, gas tight manifolds with thermo-laminated heat shields; dual turbochargers with water cooled bearings and thermo-laminated heat shields; vertical exhaust outlet, 203 mm (8 in.) round flanged outlet

Flywheel and Flywheel Housing

SAE No. 00 (183 teeth)

Fuel System

RH fuel filter with service indicators, fuel transfer pump, electronically controlled unit injectors

Instruments

RH instrument panel with oil pressure, water temperature, and fuel pressure gauges; system DC voltage gauge; air inlet restriction gauge; exhaust temperature gauge; fuel and oil filter differential pressure gauges; service meter; tachometer; instantaneous fuel consumption; four-position start-stop

Lube System

Top-mounted crankcase breather, RH oil filter and oil level gauge, gear-type oil pump, deep sump oil pan

Mounting System

Engine length mounting rails, 254 mm (10 in.), C-channel

Power Take-Offs

Lower RH and LH accessory drive, two-sided front housing

General

Vibration damper and guard, Caterpillar yellow paint, lifting eyes

Marine Auxiliary Engine

3516B

1383 bkW (1853 bhp) 1879 mhp @ 1200 rpm

SPECIFICATIONS**V-16, 4-Stroke-Cycle-Diesel**

Emissions IMO compliant
Displacement 69 L (4210 cu. in.)
Bore 170 mm (6.7 in.)
Stroke 190 mm (7.5 in.)
Aspiration Turbocharged-Aftercooled
Governor Electronic
Engine Weight, Net Dry (approx) .. 8029 kg (17700 lb)
Capacity for Liquids
Cooling System (engine only) .. 365.5 L (96.6 U.S. gal)
Lube Oil System 798.7 L (211 U.S. gal)
Oil Change Interval 1000 hr
Caterpillar DEO 10W30 or 15W40
Rotation (from flywheel end) ccw or cw

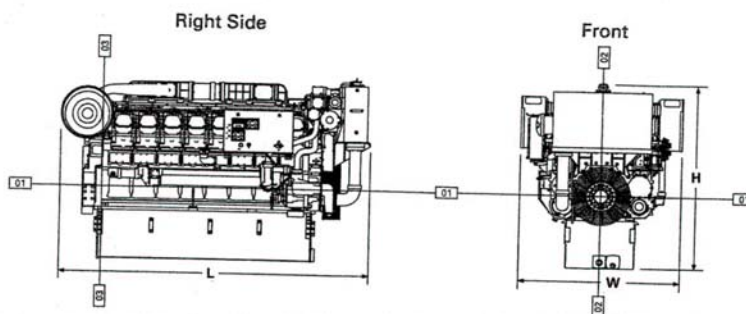
ACCESSORY EQUIPMENT

24V 60 Amp Alternator
24V Electric Prelube Pump
24V Electric Starting Motor
Air Inlet Overspeed Shutoffs
Air Starting Motor
Auxiliary Drive Pulley and Shaft
Crankshaft Pulleys
Customer Communication Module (CCM)
Dual Jacket Water Heater
Duplex Fuel Filter
Duplex Oil Filter
Engine-Mounted Instrument Panel
Exhaust Elbow, Flange, Flexible Fitting
Front Enclosed Clutch, Front Stub Shafts
Fuel Priming Pump
Generator — 1285 to 1825 kW
Air Filter, Bearing Temperature Detectors, Low Voltage Extension Box, RFI Filter, Voltage Regulator (Auto, Digital, Manual)
Heat Exchanger
Instrument Panel Extension Harness — 8M or 16M
Keel Cooling Connections
Load Sharing Module
Premium Wiring Harness
Program Relay Control Module
Pyrometer and Thermocouples
Pyrometer Extension Harness — 8M or 16M
Radiator Cooling Conversion
Self-Priming Auxiliary Sea Water Pump
Shutoff and Alarm Contactors for Oil Pres. and Water Temp.
Spare Parts Kit
Sump Pump
Upper RH Front Accessory Drives
Vibration Isolators

PERFORMANCE DATA**Turbocharged-Aftercooled**

DM4609-00 Aftercooler Temperature 30°C (86°F)

1383 bkW (.8 pf) 1853 bhp			
% load	bkW	Lph	gph
100	1344	334.2	88.3
75	1007	246.7	65.2
50	675	166.4	44.0
25	346	93.5	24.7

CATERPILLAR**3516B MARINE AUXILIARY ENGINE — 1383 kW (1853 bhp)****DIMENSIONS***

	mm	in.
Overall Length		
Length from front to rear face of block	3428.6	135.0
Length from rear face of block to back of flywheel housing	2555.0	100.6
	468.6	7.1
Overall Height		
Height from crankshaft centerline to top of engine	2052.6	80.1
Height from crankshaft centerline to bottom of oil pan	1317.9	51.9
	734.7	28.9
Overall Width		
Width from crankshaft centerline to port side (left side)	1785.0	70.3
Width from crankshaft centerline to starboard side (right side)	892.5	35.1
	892.5	35.1

	Front		Rear	
	mm	in.	mm	in.
Customer mounting hole diameter	27.5	1.1	27.5	1.1
Width from crankshaft centerline to side	444.5	17.5	444.5	17.5
Length from rear face of block to mounting hole	2320.0	91.3	65.7	2.6
	2396.2	94.3	141.9	5.6
			10.5	0.4

*Illustrations and dimensions from drawing: 145-8895.

RATING CONDITIONS**Engine Performance Parameters**

Power.....	±3%
Specific Fuel Consumption.....	±3%
Fuel Rate.....	±5%

Ratings are based on SAE J1228/ISO8665 standard conditions of 100 kPa (29.61 in. Hg), 25°C (77°F), and 30% relative humidity. These ratings also apply at ISO3046/1, DIN6271/3, and BS5514 conditions of 100 kPa (29.61 in. Hg), 27°C (81°F), and 60% relative humidity.

Fuel rates are based on fuel oil of 35° API [16°C (60°F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29°C (85°F) and weighing 838.9 g/L (7.001 lb/U.S. gal).

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for additional information.

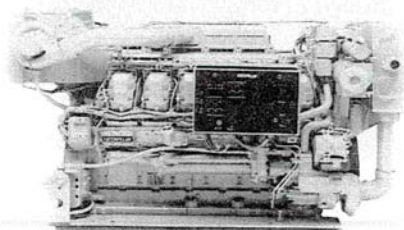
Performance data is calculated in accordance with tolerances and conditions stated in this specification sheet and is only intended for purposes of comparison with other manufacturers' engines. Actual engine performance may vary according to the particular application of the engine and operating conditions beyond Caterpillar's control.

TMI Reference No.: DM4609-00 (6-15-01)

Materials and specifications are subject to change without notice.

LEHM1595-00 (6-01)

The International System of Units (SI) is used in this publication.
Printed in U.S.A.©2001 Caterpillar
All rights reserved.

CATERPILLARShown with
Accessory Equipment**STANDARD EQUIPMENT****Air Inlet System**

Corrosion-resistant, separate circuit aftercooler core (air side); regular duty air cleaner; dual turbochargers, 152 mm (6 in.) OD

Cooling System

Non-self-priming centrifugal auxiliary sea water pump, gear driven centrifugal jacket water pump, auxiliary fresh water pump, expansion tank, oil cooler, thermostats and housing with 92°C (198°F)

Exhaust System

Dry, gas tight manifolds with thermo-laminated heat shields; dual turbochargers with watercooled bearings and thermo-laminated heat shields; vertical exhaust outlet, 305 mm (12 in.) round flanged outlet

Flywheel and Flywheel Housing

SAE No. 00 (183 teeth)

Fuel System

RH fuel filter with service indicators, fuel transfer pump, Electronic Unit Injector (EUI) fuel system

Instruments

RH instrument panel with oil pressure, water temperature, and fuel pressure gauges; system DC voltage gauge; air inlet restriction gauge; exhaust temperature gauges; fuel and oil filter differential pressure gauges; service meter; tachometer; instantaneous fuel consumption; 4-position start-stop

Lube System

Top-mounted crankcase breather, RH oil filter and oil level gauge, gear-type oil pump, deep sump oil pan

Mounting System

Engine length mounting rails, 254 mm (10 in.), C-channel

Power Take-Offs

Lower RH and LH accessory drive, two-sided front housing

General

Vibration damper and guard, Caterpillar yellow paint, lifting eyes

Marine Auxiliary Engine

3512B

1257 bkW (1686 bhp) 1710 mhp @ 1500 rpm

SPECIFICATIONS**V-12, 4-Stroke-Cycle-Diesel**

Displacement 51.8 L (3158 cu. in.)
Bore 170 mm (6.7 in.)
Stroke 190 mm (7.5 in.)
Aspiration Turbocharged-Aftercooled
Governor Electronic
Engine Weight, Net Dry (approx) .. 6532 kg (14400 lb)
Capacity for Liquids
Cooling System (engine only) .. 289.3 L (76.4 U.S. gal)
Lube Oil System 613 L (162 U.S. gal)
Oil Change Interval 1000 hr
Caterpillar DEO 10W30 or 15W40
Rotation (from flywheel end) ccw or cw

ACCESSORY EQUIPMENT

24V 60 Amp Alternator
24V Electric Prelube Pump
24V Electric Starting Motor
Air Inlet Overspeed Shutoffs
Air Starting Motor
Auxiliary Drive Pulley and Shaft
Crankshaft Pulleys
Customer Communications Module — CCM
Dual Jacket Water Heater
Duplex Fuel Filter
Duplex Oil Filter
Exhaust Elbow, Flange, Flexible Fitting
Front Enclosed Clutch
Front Stub Shafts
Fuel Priming Pump
Generator — 880 to 1360 kW, Air Filter, Bearing
Temperature Detectors, Low Voltage Extension Box,
RFI Filter, Voltage Regulator (Auto, Digital, Manual)
Heat Exchanger
Instrument Panel Extension Harness — 8M or 16M
Keel Cooling Connections
Load Sharing Module
Premium Instrument Panel
Premium Wiring Harness
Program Relay Control Module
Pyrometer and Thermocouples
Pyrometer Extension Harness — 8M or 16M
Radiator Cooling Conversion
Self Priming Auxiliary Sea Water Pump
Shutoff and Alarm Contactors for Oil Pres. and Water Temp.
Spare Parts Kit
Standard Sump Oil Pan
Sump Pump
Upper RH Accessory Drives
Vibration Isolators

PERFORMANCE DATA

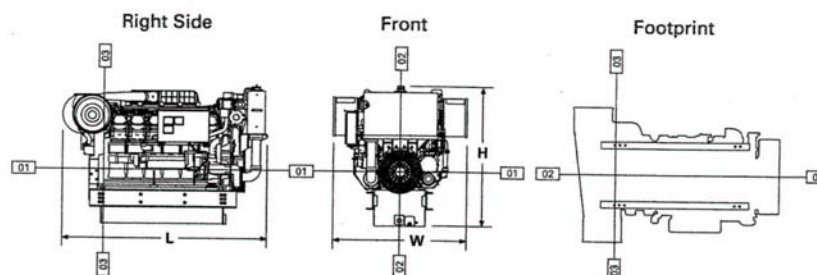
Turbocharged-Aftercooled

DM4595-00 Aftercooler Temperature 30°C (86°F)

1257 bkW (.8 pf) 1686 bhp			
% load	bkW	Lph	gph
100	1257	291.9	77.1
75	939	225.3	59.5
50	625	158.4	41.8
25	316	89.8	23.7

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

CATERPILLAR®**3512B MARINE AUXILIARY ENGINE — 1257 kW (1686 bhp)****DIMENSIONS***

	mm	in.
Overall Length	3038.6	119.6
Length from front to rear face of block	2420.0	95.3
Length from rear face of block to back of engine	618.6	24.4
Overall Height	2073.8	81.7
Height from crankshaft centerline to top of engine	1267.1	49.9
Height from crankshaft centerline to bottom of rails	806.7	31.8
Overall Width	1988.0	78.3
Width from crankshaft centerline to port side (left side)	994.0	39.1
Width from crankshaft centerline to starboard side (right side)	994.0	39.1
Customer mounting hole diameter		
Width from crankshaft centerline to side		
Length from rear face of block to mounting hole		
	mm	in.
	23.8	0.9
	444.5	17.5
	1758.0	69.2
	1834.2	72.2
	mm	in.
	23.8	0.9
	444.5	17.5
	65.7	2.6
	141.9	5.6
	10.5	0.4

*Illustrations and dimensions from drawing: 125-6279.

RATING CONDITIONS**Engine Performance Parameters**

Power.....	±3%
Specific Fuel Consumption	±3%
Fuel Rate.....	±5%

Ratings are based on SAE J1228/ISO8665 standard conditions of 100 kPa (29.61 in. Hg), 25°C (77°F), and 30% relative humidity. These ratings also apply at ISO3046/1, DIN6271/3, and BS5514 conditions of 100 kPa (29.61 in. Hg), 27°C (81°F), and 60% relative humidity.

Fuel rates are based on fuel oil of 35° API [16°C (60°F)] gravity having an LHV of 42 780 kJ/kg (18,390 Btu/lb) when used at 29°C (85°F) and weighing 838.9 g/L (7.001 lb/U.S. gal).

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for additional information.

Performance data is calculated in accordance with tolerances and conditions stated in this specification sheet and is only intended for purposes of comparison with other manufacturers' engines. Actual engine performance may vary according to the particular application of the engine and operating conditions beyond Caterpillar's control.

TMI Reference No.: DM4595-00 (6-15-01)

Materials and specifications are subject to change without notice.

LEHM1593-00 (6-01)

The International System of Units (SI) is used in this publication.

Printed in U.S.A.

©2001 Caterpillar
All rights reserved.

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

REFERENCE DRAWINGS







SECTION - MECHANICAL FLOOR PLAN

DRAWN BY: J. H. B. 11

CHECKED BY: J. H. B. 11

DATE: 11/11/51

PROJECT: 11/11/51

SHEET: 11/11/51

THIS DRAWING IS THE PROPERTY OF THE ARCHITECT AND IS NOT TO BE REPRODUCED OR COPIED IN ANY MANNER WITHOUT HIS WRITTEN PERMISSION.



Architectural floor plan of the 1st floor of the National Maritime Museum. The plan shows a large central exhibition hall with several smaller rooms, a reception area, and a lobby. Dimensions are provided for various sections of the building. Structural elements like columns and beams are indicated. A north arrow points towards the upper right.

PLAN: OPERATING FLOOR
 NATIONAL MARITIME MUSEUM
 1st FLOOR
 1/4" = 1'-0"

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

POWELL KUGLER, INC.
 600 S. AUSTRALIAN AVE., SUITE 600
 WEST PALM BEACH, FL 33401-6237

ALTERNATIVE #41
 PLAT - OPERATING FLOOR
 1/4" = 1'-0"

800 555-6600 A-1
 800 555-6600 A-1
 800 555-6600 A-1

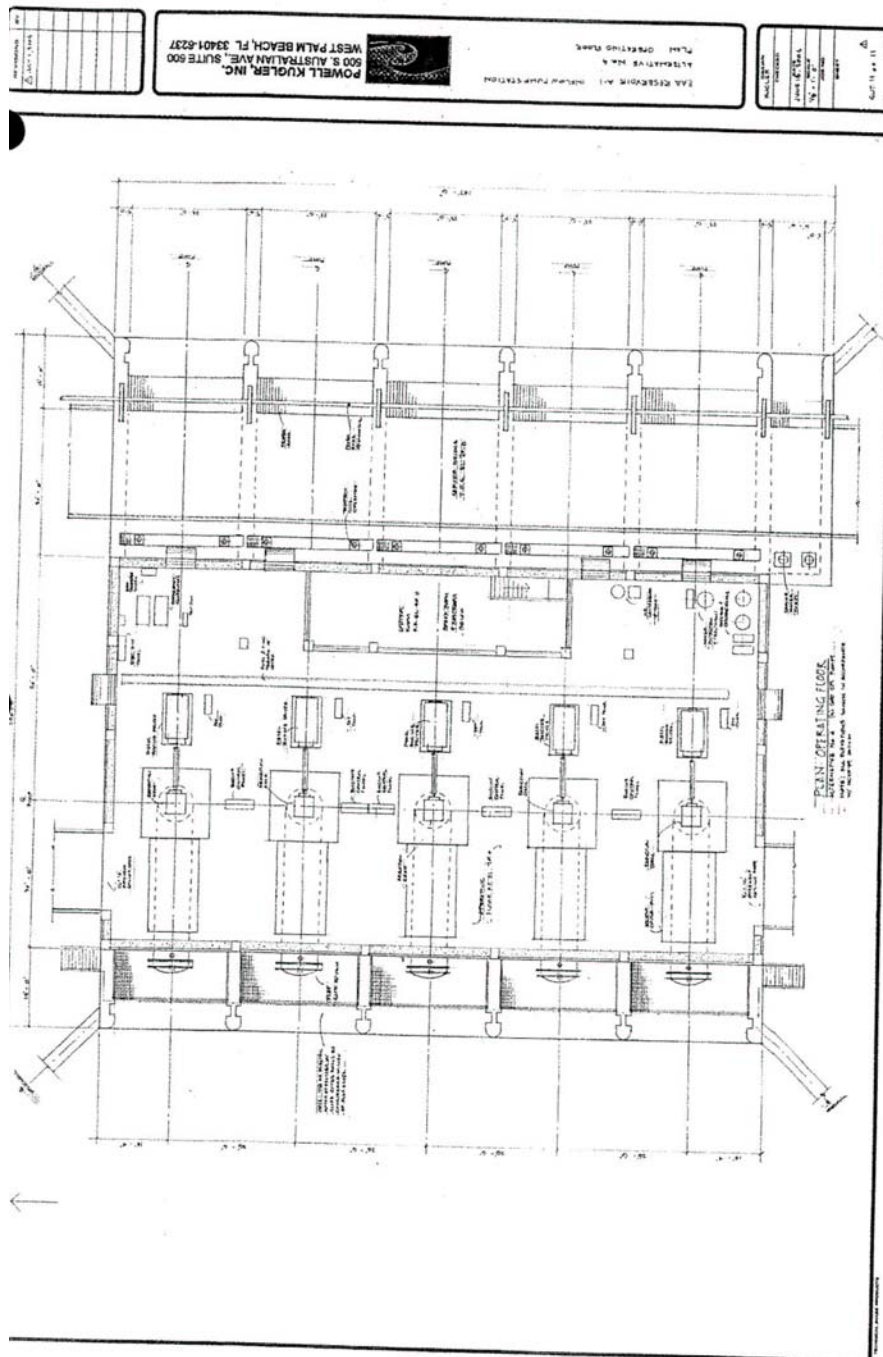
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

[illegible]



South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005



South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

July, 2005

